Bulletin
of the
Geological Society of America

VOLUME 53 DECEMBER 1, 1942 NUMBER 12, PART 2

CONTENTS

PAGES

Abstracts of The Geological Society of America
December meeting at Ottawa (canceled) **1795–1814**
Cordilleran Section meeting at California Institute of Technology in April **1815–1826**
Abstracts of the Paleontological Society
December meeting at Ottawa (canceled) **1827–1834**
Pacific Coast Branch meeting at California Institute of Technology in April **1835–1840**
Abstracts of Society of Vertebrate Paleontology
December meeting at Ottawa (canceled) **1841–1844**
Abstracts of Section E, American Association for the Advancement of Science
December meeting at New York (canceled) **1845–1852**

Subscription, $10 per year.

Publication Office: Florida Avenue and Eckington Place, Washington, D. C.

Communications for publication should be addressed to The Geological Society of America, Dr. H. R. Aldrich, Secretary, 419 West 117th Street, New York, N. Y.

NOTICE.—In accordance with the rules established by the Council, claims for non-receipt of the preceding number of the Bulletin must be sent to the Secretary of the Society within three months of the date of the receipt of this number in order to be filled gratis.

Entered as second-class matter in the Post-Office at Washington, D. C., under the Act of Congress of July 16, 1894.

Accepted for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 8, 1918.

PRESS OF JUDD & DETWEILER, INC., WASHINGTON, D. C.

ABSTRACTS OF THE GEOLOGICAL SOCIETY OF AMERICA

DECEMBER MEETING AT OTTAWA (CANCELED)

WATER SUPPLY IN NORTH CAROLINA COASTAL PLAIN

BY WILLARD BERRY

In the last several years increased drilling for water in the Coastal Plain has permitted a better understanding of the subsurface geology. Some areas where more intensive operations have been undertaken show abundant water at the depths of 250 and 500 feet. In the areas south of the Neuse River the Trent limestone is an important water horizon. Below the Trent water may be found in older beds, but in the few wells deeper than about 500 feet the water has been salt or otherwise unusable. North of the Neuse River the Miocene seems to be one of the chief horizons. Water is produced from the Patuxent (Cretaceous) but its quality is not so good as that from the younger rocks.

Throughout the eastern portion of the Coastal Plain wells more than about 500 feet may reach salt waters, apparently the underground encroachment of sea water.

Examination of well samples for microfossils, soluble carbonates, and heavy minerals and mechanical analysis of the carbonate-free sediments have made correlation more certain.

There seems to be a usable factor in the ratio of heavy to light mineral fraction rather than in the kinds of heavy and light minerals especially as the source was more or less constant, but the elevation differed both from uplift and denudation. The different percentages apparently representing the speed of erosion show more heavy minerals with rapid erosion and fewer as denudation progressed.

CORRELATION OF GRANITES

BY MARGARET FULLER BOOS

The comagmatic province of the Front Range in Colorado and Wyoming has produced three generations of pre-Cambrian granite batholiths. Correlation of widely separated granite bodies belonging to the same generation has been established by the concurrent use of several methods:

(1) Field relationships which establish sequence of intrusion.
(2) Petrofabrics.
    a. Megascopic—color, texture, grain pattern, grain orientation, intergrowths, characteristic twinning.
    b. Microscopic—accessory mineral associations, replacements, relic structures, secondary minerals.
(3) Heavy mineral—abundance and associations.
(4) Spectroscopic analysis of granites—qualitative and quantitative rare-earth analyses.
(5) Radioactivity.
(6) Pegmatites—distinctive features include zonation and structure of pegmatite body, mineral content, mineral abundance, intergrowths. Spectroscopic patterns of minerals in pegmatites—particularly abundance of rare-earth elements in tourmaline, biotite, and other micas, garnet and ferro-manganese compounds associated with garnet and intergrown with it.
(7) Correlation of widely separated pegmatites to each other and to their parent granites by spectroscopic and radioactive measurements.

The Sherman granite of Wyoming and the Pikes Peak granite of south-central Colorado, although widely separated aerially, are closely related according to the evidence listed under (1), (2), (3), (4), (6), and (7); radioactivity tests are not yet complete. In the same way the youngest pre-Cambrian granites—Silver Plume batholith, Log Cabin batholith, Longs Peak-St. Vrain batholith, Kenosha batholith, Cripple Creek batholith, and Indian Creek plutons—are nearly identical and are undoubtedly "blood brothers" if not "identical twins."

SEQUENCE OF ORDOVICIAN CONODONT FAUNAS IN KENTUCKY AND ADJACENT STATES

BY E. B. BRANSON AND C. C. BRANSON

During the past year the junior author has collected conodonts from nearly all the named stratigraphic units of the Ordovician in the Cincinnati Arch. The sequence of conodont faunas is unparalleled in other areas. The known faunas and their relationships so far as known are presented in the table. Conodonts were collected from each of the formations listed below.

Richmond group.

Elkhorn, Whitewater, Saluda, Liberty, Waynesville, Arnheim.

No Richmond conodont fauna has been described. New genera predominate.

Maysville group.

Mt. Auburn, Corryville (Tate), Bellevue, Fairmont, Mt. Hope.

The Maysville contains an Eden fauna in the Cincinnati area and a Richmond fauna in central Kentucky.

Eden group.

McMicken, Southgate, Economy, Fulton.

Conodonts are related to the Maquoketa forms, although the Maquoketa is presumably Richmond.

Cynthiana group.

Roger's Gap, Greendale, pre-Greendale.

Upper Lexington fauna with new elements.

Perryville. A unique fauna.

Lexington group.

Woodburn, Brannon, Benson, Jessamine, Hermitage, Curdsville.

Decorah fauna.

Tyrone. Conodonts closely resemble the Camp Nelson conodonts.

Oregon. Contains a Camp Nelson fauna.

Camp Nelson. Conodonts resemble those from the Joachim.

REVISION OF ROCK SERIES OF MOUNT DESERT ISLAND

BY GEORGE HALCOTT CHADWICK *

The nomenclature and relative ages of the indurated rocks of Mount Desert Island, Maine, are as follows:

7 Trap dikes, believed to be Triassic (Newark group, Redfield, 1856).

6 Cadillac granite, probably indivisible (Chadwick, 1937).

Synonym—Cadillac Mountain granite (Stupka, 1935), undefined.

5 Prettymarsh diorite and coeval diabase (nomen novum, 1942).

4 Ireson felsite of intrusive dikes, laccolith (Chadwick, 1939).

* With permission of National Park Service.

3 Frenchman's Bay stratified series (Crosby, 1881) in two facies:
  a) Bar Harbor detrital facies (Shaler, 1889, emended);
  b) Cranberry Island volcanic facies (Shaler, 1889).
  Synonyms—Schooner Head, Sutton's Island (Shaler, 1889).

UNCONFORMITY

2 Post-Bartlett granite gneiss (no formation name intended).
1 Bartlett's Island schist (Shaler, 1889).
  Synonym—Ellsworth schist (Smith, Bastin, and Brown, 1907).

The lowest member was intruded, orogenically metamorphosed, deeply eroded, peneplaned. The age need not be greater than Cambrian, the orogeny Taconian.

The succeeding strata (four "series" of Shaler) are a unit, the age presumably Silurian (Niagaran) as at North Haven 30 miles west. The two facies interfinger, no age differences being indicated.

Deposition of overlying strata, now gone but present in New Brunswick, continued to Cadillac time as shown by increasing coarseness of grain from felsite to granite. Acadian folding occurred mostly between Ireson and Prettymarsh, hence Ireson is late Silurian or early Devonian, Prettymarsh later Devonian. Evidence accumulates that Cadillac granite may form a pseudobatholith injected during Appalachian orogeny.

Deep erosion preceded the trap dikes.

LACCOLITHS OF FRENCHMAN'S BAY, MAINE

BY GEORGE HALCOTT CHADWICK *

The "laccolitic" nature of the Ireson felsite mass of Ireson's Hill, Mount Desert Island, Maine, was suggested hesitantly by Shaler in 1889 and seems fully assured today, with possibly other such in the region that were later greatly fragmented by Prettymarsh diorite or Cadillac granite.

More striking is the discovery that a very pretty group of laccoliths has stood in conspicuous view from Bar Harbor all these years, in the five "Porcupines" or islands in Frenchman's Bay that encircle the harbor. The mass of each island is Prettymarsh diabasic diorite, in lenticular form visibly mushroomed over gently north-dipping Bar Harbor sedimentary strata and fed by dikes intersecting these beds. On the north side of at least one of this group, Bar Island, remnants of overlying Bar Harbor strata dip north under the water. The northward tilt of each laccolith may be subsequent to intrusion, or, more probably, the diorite may have intruded beds already dipping.

Neighboring hills on the main island, facing Frenchman's Bay, at Sol's Cliff, Great Head, and elsewhere, are of the same nature—diorite reposing on sedimentary beds. Ironbound Island, east of the Porcupines, is a more widespread sill-like sheet.

Columnar jointing (palisading) is marked on Long and Bald Porcupines and Ironbound.

METASOMATIC "GRANITE" IN MAINE

BY GEORGE HALCOTT CHADWICK *

The southwestern lobe of the island of Mount Desert, Maine, is of low relief, in strong contrast to the mountain range of Cadillac granite rising steeply on its north. Here and there around the ragged shore of this lobe, or along the mountain rim, are

* With permission of National Park Service.

extensive patches of Cranberry Island felsite flows, in part quartz melaphyres. Centrally the area is mostly a rather fine-grained or "aplitic" pink to white "granite" occasionally reaching a coarseness like that of the Cadillac granite.

The local quarrymen sharply divide this rock, which they call "sugar granite," from the Cadillac, rejecting it as commercially useless. Furthermore, in several localities there is a complete transition exposed from the dark-blue melaphyre within a few rods into the pink "aplitic" rock. Nowhere does the crystal grain of the latter have the clear definition of the Cadillac but looks obscure and diffuse. There is greater porosity, irregularity of grain, presence of sprawling quartz lumps up to a foot or more, and numerous tiny geodic cavities; the lithic variability contrasts with widespread uniformity of the Cadillac; the rock sends out no dikes, holds no foreign inclusions, and is cut by dikes of Prettymarsh type as well as locally by Cadillac dikes.

These field relations prove that the "sugar granites" are a mass (leptynolite?) of Cranberry Island lava flows, tuffs, and ashes metasomatized, presumably by the advance emanations of the Cadillac magma. All three have apparently the same norm (alaskose?).

TOPOGRAPHIC SIGNIFICANCE OF FACIES DIFFERENCES IN THE MIOCENE FLORAS OF OREGON

BY RALPH W. CHANEY

Large collections of the Mascall and related floras have recently been made in eastern Oregon. These floras show a general homogeneity consistent with the stratigraphic and lithologic relations of the beds in which they occur and are considered to represent essentially the same stage in the Upper Miocene.

There is an areal variation in representation of certain dominant species which may best be interpreted as resulting from differences in environment. At the type locality in the John Day Basin, Tertiary species of swamp cypress, black oak, and hickory were abundant members of a forest similar to that now living along major streams in southern Illinois and Indiana. Forty miles eastward in the Blue Mountains, these species are displaced as dominants by beech, birch, and upland conifers whose modern equivalents occupy the hillsides of Kentucky. In the Stinking Water Basin, 60 miles to the south, a flora with dominant oaks and conifers suggests a less humid environment.

A generally similar distribution of forest types is now found in eastern Oregon, resulting from the climatic influence of the mountains separating the John Day and Stinking Water Basins. The existence of these mountains during the Miocene is suggested not only by a corresponding vegetational pattern of the fossil floras but by the areal and structural relations of pre-Tertiary rocks in the core of the Strawberry Mountains.

EOCENE RADIOLARIANS FROM THE KREYENHAGEN SHALES OF THE CHARLESTON QUADRANGLE WEST SIDE OF SAN JOAQUIN VALLEY, CALIFORNIA

BY BRUCE L. CLARK AND ARTHUR S. CAMPBELL

The radiolarians discussed in this paper come from the Kreyenhagen shales of the Charleston quadrangle. In this area radiolarian-bearing shales have a maximum thickness of a little over 500 feet. They are underlain by unfossiliferous sandstones which are probably of Domengine (Middle Eocene) age and overlain by coarse conglomerates and arkosic sandstones of San Pablo (Upper Miocene) age. The upper

portion of the Kreyenhagen as exposed farther south and known as the Tumey formation is missing in this area.

The shales in the Charleston area are equivalent to the lower portion of the "Kreyenhagen shales" as found north of Coalinga; these beds are of Upper Eocene age and are equivalent in part to the Markley formation of the Mount Diablo area and probably include beds equivalent to the Kellogg shale which immediately underlies the Markley formation. Several fairly large well-preserved assemblages of radiolarians were found in the Charleston section. Some of these are very similar to assemblages found in the Mount Diablo area and contain a considerable number of species in common. About 90 species were recognized, a fairly large number of which are new.

CTENOSTOMATOUS BRYOZOA; CARBONIFEROUS AND PERMIAN FORMS

BY G. E. CONDRA AND M. K. ELIAS

In the second paper devoted to monographic treatment of the late Paleozoic Bryozoa of North America the pseudoparasitic adnate and immersed forms, customarily classified as ctenostomes, are described. Relationship between the two most important genera of the group, *Ascodictyon* and *Vinella*, is discussed at length, and their concepts are revised. *Ptychocladia* is described in detail on prolific material from Nebraska. This flattened adnate genus is removed from Bryozoa and considered an alga or a foraminifer, more probably the latter. *Bascomella* is provisionally retained among ctenostomes and is shown to be completely immersed in shells of invertebrates. Other forms enveloped by growing shell substance or subsequently excavated in it are described, and their biologic relationships are discussed.

Thirteen new species and one new genus are established.

MOCCASIN FORMATION IN SOUTHWESTERN VIRGINIA*

BY BYRON N. COOPER

The Moccasin formation, named by Campbell from Moccasin Creek, near Gate City, Scott County, Virginia, was originally described as a red argillaceous limestone with a maximum thickness of 500 feet and was said to overlie blue flaggy Chickamauga limestone. Beds included in the type Moccasin consist of 465 feet of red argillaceous limestone, calcareous mudrock, siltstone, and thin intercalations of bluish-gray calcilutyte. The type Moccasin is underlain by the following stratigraphic zones, in descending order: 54 feet of fine-grained limestone containing *Camarocladia* cf. *C. gracilis*, 28 feet of coarse-grained limestone containing *Cryptophragmus antiquatus*, 40 feet of calcilutyte containing *Tetradium cellulosum*, 42 feet of red straticulate mudrock, and 5 feet of calcareous sandstone. The term Lowville-Moccasin has been used recently for a unit including all these zones. The gray limestones beneath the thick body of red mudrock and above the red straticulate zone have been regarded as an intercalation of Lowville limestone within the Moccasin formation.

The *Camarocladia*-bearing limestones at the top of the so-called Lowville are undoubtedly part of the "blue, flaggy Chickamauga" limestone said by Campbell to underlie the Moccasin. Thus, the limestone which has been called Lowville, the red straticulate mudrock, and the sandstone were originally excluded from the Moccasin.

* Published with the permission of the State Geologist of Virginia.

Since the sandstone and red straticulate mudrock are older than the true Moccasin, the limestones identified as Lowville are not an intercalation within the Moccasin, and the so-called Lowville and Moccasin are not equivalent facies. Thus, the term Lowville-Moccasin should no longer be used.

TERTIARY TROUGH NEAR CAMP DAVIS, WYOMING

BY A. J. EARDLEY

A fossil horse tooth of upper Miocene or lower Pliocene age was found in limestone beds which separate two groups of conglomerate beds in a narrow trough 15 miles south of Jackson, Wyoming. The conglomerate and interbedded limestone had previously been referred to as the Almy of Paleocene age. Detailed mapping along the borders of the deposit reveals two pre-conglomerate episodes of deformation: (1) folding and thrusting, and (2) high-angle faulting in a zone superposed on and extending at an acute angle across the folds and thrusts. The zone of faults, together with subsequent erosion, formed an escarpment against which the conglomerate accumulated. A third episode of deformation is recorded in the folding and faulting of the conglomerate. This occurred before the Black Rock (?) erosion surface was formed and strengthens the previous conclusion of Blackwelder that the surface is late Pliocene or early Pleistocene.

WALCHIA ASSOCIATED WITH DIAGNOSTIC EARLY PENNSYLVANIAN FORMS IN CENTRAL COLORADO

BY MAXIM K. ELIAS

The occurrence of *Walchia* and early Pennsylvanian marine invertebrates in the same rocks in central Colorado was a subject of paleontologic controversy for many years. Unstable lithology of these Paleozoic rocks and local faulting complicated establishment of stratigraphic relationship between marine faunas and *Walchia*.

Previous field research in the areas of McCoy and Minturn by Roth, Lovering, Donner, Bassett, and Brill and the descriptions of the fossils by Girty, Roth and Skinner, and Arnold brought out much important stratigraphic and paleontologic information. In the course of field and laboratory research of 1942 important geological sections previously measured were re-examined, and the position of fossils in them checked. A new geological section 3 miles southeast of McCoy was studied, measured, and the critical fossils in it collected. It was selected because of gentle inclination of beds, perfect continuity, and absence of faults. In it a horizon with *Walchia* flora was found about 140 feet below marine beds with *Fusulina, Wedekendellina, Mesolobus,* and other invertebrates identical with the diagnostic forms of Upper Des Moines age. In another locality 2 miles north of Minturn *Walchia* was found on the same slab with a good *Annularia radiata,* a typical early Pennsylvanian plant.

X-RAY PETROLOGY OF SOME FINE-GRAINED FOLIATED ROCKS

BY H. W. FAIRBAIRN

X-ray examination of oriented thin plates of some fine-grained foliated rocks (slate and shale) shows the following:

(1) A definite relation between the angular spread of the reflections from the oriented platy minerals and the cleavability of the rock. The smaller the spread the better the foliation.

(2) Greater angular spread of reflections from platy minerals results where the X-radiation is parallel to the lineation than where it is perpendicular to it. No lineation was discovered by X-ray analysis which was not easily visible in the specimen concerned.

(3) Parting of shale is explained in the same way as foliation in schists—*i.e.*, by parallel orientation of platy minerals.

(4) Supplementary optic examination of the quartz in one of the rocks gives a typical girdle orientation of the axes, although random orientation is indicated from its X-ray photograph.

(5) The platy minerals in the rocks can be classified as kaolinite (±chlorite) and white mica (muscovite and hydromuscovite). Their relative proportions can be estimated by inspection of the chief reflection rings of each group.

(6) In the slates examined, white mica exceeds kaolinite where cleavability is high; kaolinite exceeds white mica where cleavability is low.

GROWTH OF THE NORTH AMERICAN ICE SHEET DURING THE WISCONSIN AGE

BY RICHARD FOSTER FLINT

The evidence of separate Labradorian and Keewatin centers of radial glacial flow is confined almost wholly to very late Wisconsin time and indicates that these centers shifted their positions widely even during that short time. There is no evidence that these centers ever were the sites of independent glaciers; their importance has been overemphasized. The North American ice sheet, during the Wisconsin maximum, was recognized as a single mass and named the Laurentide ice sheet before the names Labradorian and Keewatin were applied.

The Laurentide ice sheet is believed to have originated as mountain glaciers chiefly in the conspicuous highlands of eastern Quebec, Labrador, and Baffin Island. Nourished by moist maritime air masses derived mainly from the south and southeast and moving northward and eastward, these glaciers coalesced into piedmont glaciers. By continued growth southward and westward toward the principal sources of their nourishment, the piedmonts thickened and spread, burying the highlands in which they had originated. Ultimately they formed a vast ice sheet that extended from the east coast to the Cordillera. Expansion toward the east was prevented by the deep water of the Atlantic, in which the ice broke up and floated away.

Glacial-anticyclonic winds are assumed to have been subordinate to cyclonic storms in nourishing the ice sheet. The Labradorian, Keewatin, and other centers of outflow recorded by striae were broad low domes on the surface of the ice and were caused by exceptional concentrations of snowfall. While the ice sheet was shrinking, these domes shifted their positions.

STRUCTURAL SURFACES ON THE WEST SLOPE OF THE TETON RANGE, WYOMING

BY F. M. FRYXELL AND LELAND HORBERG

The Tetons originated through westward tilting of a mountain block involving mainly pre-Cambrian crystallines and 2800 feet of overlying Paleozoic sedimentaries. On the west slope, canyon cutting has largely reduced the sedimentary cover to intercanyon strips. The section so exposed includes several shales (Gros Ventre, Darby, Amsden); and backslope stripping progresses largely through sapping at these horizons, with resultant orderly retreat of escarpments formed by more

resistant formations (Flathead quartzite, Death Canyon limestone, Bighorn dolomite, Wells sandstone).

The strata are inclined, and one may distinguish between sapping in the direction of the strike and sapping down and up the dip.

"Strike sapping," illustrated along canyons, produces west-sloping paired benches limited by infacing cliffs, whose recession reduces the intercanyon sedimentaries to ever narrower remnants. Mechanics of sapping resemble those in plateau regions of horizontal beds.

"Downdip sapping" produces similar and broader surfaces at 8000 to 11,000 feet likewise sloping west and limited by east-facing escarpments. Westward (*i.e.*, downdip) recession, carrying these features to progressively lower elevations, is stripping the backslope of its sedimentary cover from the top down. The surfaces are being developed well above local base levels and independent of them, being held up by resistant beds. (Other surfaces truncating structure and bearing gravels are referred to earlier erosion cycles.)

Agencies of downdip sapping are wasting, sheetwash, and, subordinately, corrasion, solution, and nivation. Runoff (partly meltwater of snowfields) seeks the low west margin of each surface and persistently attacks the base of the limiting escarpment, causing undermining and collapse.

"Updip sapping" appears negligible. (Geological Society project.)

ORIGIN OF SOME CHROMIFEROUS SANDS ALONG THE SOUTHWESTERN OREGON COAST

BY A. B. GRIGGS AND F. G. WELLS

Exploration by the U. S. Geological Survey in co-operation with the Oregon State Department of Geology and Mineral Industries and by private groups has furnished definite data on the shape, size, content, and distribution of chromiferous sand deposits in the raised beaches or marine terraces along the southwestern Oregon coast. The deposits are concentrates of chromite and other heavy minerals and are commonly called "black sands" because of their color. They occur as layers or lenses which vary from less than a foot to more than 30 feet in thickness, from a few tens of feet to several hundred feet in width, and from a few hundred feet to a mile or more in length. Elongate parallel to the former coast lines, they are usually at or near the backs of the terraces and are covered by from 5 to as much as 100 feet of sand, clay, and gravel. The average Cr_2O_3 content of the separate deposits ranges from 5 to 9 per cent. Other minerals common in these "black sands" include garnet, olivine, pyroxene, magnetite, ilmenite, zircon, and quartz. The probable original source of the chromite is in the pre-Tertiary ultramafic rocks in the adjacent Coast Range and Klamath Mountains, although the chromite has been immediately derived in part through the reworking of Tertiary sediments. The "black sands" were concentrated by wave and current action in favorable places which are controlled by the irregularities in the coast lines and wave-cut benches.

CASPER MOUNTAIN FAULT, WYOMING

BY C. J. HARES

The Casper Mountain fault, Wyoming, has never been adequately described. It is over 15 miles long, and displacement is about 6000 feet. Basement Complex (1000 feet +) is exposed in the mountain face above the Cretaceous; patches of

Paleozoic beds are discordant upon it. Chugwater to Steel shale crop out in front of the fault, which cuts off the sharply folded Cretaceous Immigrant Gap anticline on the north and farther west is dissipated in the asymmetric Goose Egg anticline (Triassic). Eastward the fault dies out in the Cretaceous. Much loose debris with boulders 10 feet across occurs along the north side, and long bouldery aprons sloping 200 feet per mile extend about 5 miles north to the North Platte River. The gradients of these aprons are at right angles to the river, and their riverward ends are about 200 feet above the stream. The river did not form them; they were formed during the closing movements of the great fault.

Near Casper, about 4 miles from the mountain front, an older apron 100 feet higher may indicate earlier fault movement.

No late Tertiary formations are involved with the fault, yet general relations elsewhere indicate that they antedate latest faulting.

The long aprons are like the intermajor stream benches in front of the Heart Mountain and Chief Mountain overthrusts and the Uinta fault. Possibly the Casper Mountain fault extended from the Laramide Revolution to the pronounced deformation involving the late Tertiary (Oligocene, Miocene, and Pliocene) at Shawnee, Douglas, and Wheatland, Wyoming, and elsewhere. That deformation was termed (1934) the "Rocky Revolution".

The clear attachment of the aprons to the mountain at the fault indicates that upward movements of the fault were faster than erosion. Since the faulting, streams have cut across the fault line and back to the flat top of the mountain (8000 feet). Erosion has dissected the single apron, once coextensive with the fault, into several small aprons.

UPPER JURASSIC FORMATIONS OF THE SOUTHERN STATES

BY R. W. IMLAY *

Upper Jurassic formations extend from eastern Texas to Alabama, ranging in thickness from 3000 feet shoreward to 7000 feet basinward. Uniformity in composition reflects the peneplained condition and aridity of continent in early Upper Jurassic time.

The Eagle Mills formation, a red-bed facies shoreward and a salt facies basinward, ranging in thickness from 960 to more than 1780 feet, rests unconformably on late Paleozoic rocks. Its Divesian age is shown by gradation of the salt into Smackover limestone and by upper Argovian ammonites only 300 feet above the salt.

The Smackover formation, ranging in thickness from 450 feet shoreward to 1650 feet basinward, consists mainly of limestone and dolomite but in northern Louisiana includes much shale and sandstone. It contains Argovian ammonites comparable with Mexican *Dichotomosphinctes* and *Discosphinctes*.

The Buckner formation—red beds and anhydrite—generally grades downward into the Smackover, ranges in thickness from 50 to 475 feet, and is an early Kimmeridgian lagoonal deposit. Probable offshore equivalents contain the ammonites *Ataxioceras* and *Idoceras*.

The Cotton Valley formation, a red-bed facies nearshore and a dark, marine facies offshore, thickens from 1400 feet shoreward to nearly 4000 feet basinward. Its thick basal conglomerate rests on older formations along a disconformity correlated with the beginning of the Palisade disturbance, an intense orogeny in Cuba,

* Introduced by John B. Reeside, Jr.

and the Nevadian orogeny. Its lower part contains many Kimmeridgian fossils, including *Glochiceras fialar* (Oppel) and *Idoceras*. A minor disconformity terminates the red-bed facies. Erosion of highlands formed during the mid-Upper Jurassic orogeny developed the Fall zone peneplain.

GEOLOGY OF THE SIERRA CUCHILLO, NEW MEXICO*

BY RICHARD H. JAHNS†

The Sierra Cuchillo, a narrow, north-trending, eastward-tilted fault block of the basin-range type, lies in northwestern Sierra County, New Mexico. Although its northern part is shown on published maps as a great mass of volcanic rocks, the entire range presents a rather complete section of upper Paleozoic, as well as local Mesozoic sedimentary rocks. This succession has been cut by sills, dikes, and plug-like bodies of Tertiary monzonite, felsite, porphyritic rhyolite, aplite, and fine-grained granite. Unconformably overlying the sedimentary rocks is a thick volcanic series, consisting in ascending order of andesitic breccia, andesite, latite, and rhyolite with associated pyroclastics. These volcanics form eastern foothills and outlying peaks; they are in part older than and in part contemporaneous with the intrusive rocks in the core of the range. Flanking the range are poorly consolidated clastic sediments of late Tertiary and Quaternary age, associated with minor flows of Quaternary basalt.

Despite the complex of intrusive rocks, the structure of the range is relatively simple. The sedimentary beds dip eastward at moderate angles and appear to represent the west flank of a syncline that pitches gently south. Conspicuous cross faults of slight displacement are common, and a very strong fault zone involving considerable movement bounds the range on the west. Both contact-metamorphic and hydrothermal vein deposits appear throughout the range, chiefly in the Magdalena limestone, less commonly in the Abo sandstone. Magnetite, fluorite, and ores of beryllium and the base metals are the materials of greatest economic interest.

LOVELAND (PLEISTOCENE) FORMATION OF IOWA

BY GEORGE F. KAY

The Loveland formation includes deposits as old as late Yarmouth and as young as immediately pre-Iowan; the interval of deposition includes the late Yarmouth interglacial age, the Illinoian glacial age, and the Sangamon interglacial age.

The Loveland deposits until recent years were thought to be loess deposits only, but now silts, sands, gravels, and volcanic ash also are included in the formation.

Late Sangamon loess within the Illinoian drift area of southeastern Iowa has been correlated by stratigraphic methods with loess of the Loveland type area of western Iowa. However, not all Loveland loess is necessarily of late Sangamon age. As yet, sufficient field evidence has not been found to establish the succession of events which resulted in the deposition of loess and other deposits of the Loveland formation. While some of the deposits, by virtue of their relative stages of weathering and other features, can be stated to be younger or older than other similar deposits, these deposits cannot be given with any certainty a late Yarmouth, an Illinoian, or a Sangamon age.

---

* Published by permission of the Director, Geological Survey, U. S. Department of the Interior.
† Introduced by G. R. Mansfield.

In places, the Loveland silts, sands, and gravels are limited to valleys and their tributaries formed wholly within Kansan drift areas. The Kansan drift in such areas seem to have been the source of the silts, sands, and gravels. Subsequent to their deposition and before Iowan time, Loveland deposits underwent extensive erosion. In places, only remnants are now found on the walls of valleys previously well filled with Loveland deposits.

CRITICAL VELOCITY AS A CONTROLLING FACTOR IN SEDIMENTATION

BY PAUL D. KRYNINE

Modification of detritus during transport affects size, shape, surface features, and composition. Modification may affect load as a whole through selective concentration, or individual particles through selective or random attack.

The degree of modification for any given property depends upon the intensity of the modifying process and the time during which this process is actively at work.

Maximum modification (be it rounding, or breakage of a particle, or selective sorting of whole load) takes place at a certain most favorable or critical current velocity. This critical velocity differs for different properties. For the same property it also differs for different grade sizes of the same mineral.

If this critical velocity is maintained long enough the mineral in the affected grade size is selectively rounded (or broken, or deposited, or bypassed) against other minerals or other grade sizes of the same mineral.

Since maximum modification occurs if the critical velocity is maintained for a sufficient time it follows that a constant current (beach or pool) within the critical velocity range is infinitely more potent in effecting certain modifications than a fluctuating current (river) which is random in its effects.

Hence when dealing with modification of detritus during transport and deposition it is almost meaningless to think in terms of absolute distance or even of absolute time involved. The amount of time available for modification within the critical velocity range is the important feature.

FACIES RELATION AND ORIGIN OF SOME NIAGARAN CHERTS

BY HEINZ A. LOWENSTAM *

The post-Joliet formations of the Niagaran series in northeastern Illinois are characterized by interfingering deposits of bioherm and interbioherm facies. Chert is confined to the interbioherm facies and chiefly to the shaly dolomites and limestones; a little occurs in the clastic dolomites. It may be present, locally, at bioherm flanks where interbioherm and bioherm deposits overlap. The bulk of the chert occurs in biostromes composed mainly of assemblages of siliceous sponges, which are characteristic of the interbioherm biotopes. This confirms the belief expressed by Chamberlin and Salisbury, that sponges precipitated silica and opposes the hypothesis of direct chemical precipitation. An environment favorable for sponge growth promotes subsequent formation of chert. This satisfactorily explains the random distribution of chert zones, a phenomenon difficult to account for under the direct precipitation hypothesis.

Zones now devoid of sponge remains contain chert, but various factors indicate that it was also sponge-precipitated: (1) Every gradation can be found between spiculeless chert and cherts containing completely preserved sponge skeletons, sur-

* Introduced by J Harlen Bretz.

rounded by tuft and flesh spicules (indicating that presence and degree of preservation of sponge remains was dependent upon the rate of sedimentation); (2) the specialized fauna of the sponge biostromes is also found in the spiculeless chert zones but nowhere else. Silicification of fossils other than sponges at various horizons is the result of localized solution of isolated spicules and of the margins of already-formed chert nodules, a process still going on.

PHOSPHATIZATION AT MALPELO ISLAND

BY DUNCAN MC CONNELL

A petrographic study is presented of three specimens from Malpelo, a volcanic island in the Pacific Ocean. Two of the specimens show appreciable alteration by phosphatic solutions from guano. One of these is an amygdaloid in which the feldspars have been completely destroyed and replaced; the other is a phosphate rock composed essentially of phosphosiderite and strengite, a dimorphous pair with the composition $FePO_4 \cdot 2H_2O$. The third, a comparatively unaltered rock, is an augite andesite having a rather low silica content and possibly containing anemousite. The petrologic relations among aluminum-iron and calcium phosphates are discussed briefly.

STRUCTURAL SECTIONS OF KITTATINNY (BLUE) MOUNTAIN IN EASTERN PENNSYLVANIA

BY BENJAMIN L. MILLER

Probably Kittatinny (Blue) Mountain and its gaps are more widely known than any other single topographic feature in Pennsylvania. This is mainly due to the two major water gaps cut through the ridge by the Delaware and Lehigh rivers and one prominent wind gap, and not because of any especial features of the mountain itself. Students of stratigraphic geology have studied the fine sections of Lower Silurian strata exposed there and their relationship with the underlying Ordovician.

The structure of the mountain ridge as shown in the exposed strata in the Lehigh Gap and Delaware Water Gaps appears to be extremely regular in that the beds dip to the north-northwest throughout with the older disappearing beneath the younger. Some faults have been noted, but these are minor displacements and only slightly disturb the regularity.

In the excavation for a new road over the mountain through Little Gap, about 4 miles east of Lehigh Gap, the Silurian strata were exposed dipping to the south-southeast. During 1939-1941 a tunnel was driven through the base of the mountain a short distance to the east. Here also the beds were overturned.

The structural section at Little Gap disagrees with those at Lehigh Gap and the Delaware Water Gap. The writer presents sections at the three places.

BASAL HURONIAN CONGLOMERATES OF MENOMINEE AND CALUMET DISTRICTS, MICHIGAN

BY F. J. PETTIJOHN

The contacts of the Huronian and the granitic masses northeast of the Menominee and north of the Calumet districts, respectively, proved to be unconformities as earlier postulated by W. S. Bayley and coworkers. Basal conglomerates truncating the foliation of the Archean granite gneiss were found below the Lower Huronian Sturgeon quartzite in five key areas mapped in detail. The areas which provide the decisive evidence are (1) the falls of the Sturgeon River (Sec. 8, T. 39 N.; R. 29 W.), (2) Black Creek area (south half Sec. 6, T. 39 N., R. 28 W.), (3) Fern

Creek and vicinity (north half Sec. 34, T. 40 N., R. 29 W.), (4) upper Pine Creek area (north half Sec. 32, T. 41 N., R. 29 W.), and (5) Browning Creek area (north half Sec. 20, T. 41 N., R. 30 W.). In none of these places was any intrusive granite observed.

In the Fern Creek area, the basal conglomerate is overlain by a laminated argillite containing numerous ice-rafted granite blocks, which, in turn, is overlain by a tillite. The tillite, though limited in extent, is unique in the Southern Subprovince. (Geological Society project.)

TRANSPORTATION AND DEPOSITION OF HEAVY MINERALS

BY GORDON RITTENHOUSE*

The heavy-mineral composition was determined quantitatively for seven $\sqrt{2}$ size grades of samples from a transverse section of the Rio Grande channel near Bosque, N. M. The data were used to test present methods of comparing heavy minerals. All methods appear to be of limited applicability, but ratios between heavies of the same equivalent hydraulic size may be used most extensively.

The size distribution curves (by weight) of 12 heavy minerals were found to be similar in general form to size distributions of the light minerals, but displaced toward the finer sizes. Among samples, the heavy-mineral composition varies systematically with differences in average size and sorting of the light minerals. The size distribution of a heavy mineral in a fluvial deposit appears to depend on (1) the hydraulic conditions at the time and place of deposition, (2) the relative availability of the heavy in various sizes of the stream load, and (3) the equivalent hydraulic size of the heavy mineral. In the Rio Grande, the equivalent hydraulic sizes of 16 heavy minerals vary from 1.0 to 0.2 ϕ.

The hydraulic ratio (defined as the weight of the heavy mineral in a given range of sizes divided by the weight of light minerals of equivalent hydraulic size) is recommended as a genetically sound method of comparing the heavy-mineral composition of sediments. This ratio is the same in the stream load and the bed deposits. Changes in the hydraulic ratio caused by wear, selective transportation, and other factors are discussed.

RIVERS OF CENTRAL NEW BRUNSWICK

BY B. ROSE

The rivers of central New Brunswick head along the axis of folds of Devonian age. Exposures of Devonian granite trending about N. 30° E. parallel the strike of the folded rocks. From here, most of the streams flow eastward or westward, in places across flat Carboniferous sediments. Three major stream systems drain central New Brunswick—Miramichi, east to Northumberland Strait, Nipisiguit, east and north to Chaleur Bay, and Tobique, west and south to St. John River and thence to Fundy Bay.

A typical trellis drainage pattern is displayed on the Devonian and pre-Devonian folded rocks, a rectangular drainage on the Devonian granite, and consequent drainage on the flat Carboniferous rocks; this latter is in places superposed on the underlying rocks.

Three cycles of erosion are recognized in the present topography, the present postglacial cycle shown by young gorge valleys, a glacial cycle indicated by cirques

* Introduced by Eldon M. Thorp.

at the heads of small streams, and a mature to old-age cycle shown by mature upper valleys and a general accordance in levels of flat summits. A probable fourth cycle is indicated by several hills rising above a general plateau level. These hills may be monadnocks.

Many cases of piracy and stream diversion are noted. Some of these are doubtless the result of broad warping during the Mesozoic or Cenozoic eras; others are due to glacial damming, and the more recent diversions are likely due to unequal postglacial uplift.

STRUCTURAL RELATIONS OF THE VICINITY OF SCHUNEMUNK MOUNTAIN, ORANGE COUNTY, NEW YORK

BY C. F. STEWART SHARPE

Detailed geologic mapping begun by the late R. J. Colony and continued by the author reveals that many relationships considered by early workers to be of sedimentary origin are the product of a complex network of thrust, tear, and normal faults. The more significant thrusts, all of Appalachian origin, are: (1) along the northern border of the Hudson Highlands where pre-Cambrian crystallines were thrust over Hudson River shales and Wappinger limestone, (2) thrust by which the row of gneiss hills from Woodcock Hill southwestward paralleling the west side of Schunemunk Mountain were pushed northwestward over Hudson River shales and slates, (3) thrust of pre-Cambrian gneiss and Wappinger limestone over Hudson River shales 0.8 mile north of Washingtonville (may be continuous with Goose Pond Mountain and Cronomer Hill thrusts), (4) thrust bringing Neelytown limestone to the surface 2 miles southwest of Maybrook. Tear faults have resulted from differential movement on the larger thrusts.

A normal fault of Triassic or post-Triassic age borders the western side of Schunemunk Mountain, a downdropped compound synclinal block, and makes the straight eastern bases of the gneiss hills from Woodcock Hill 4 miles southwestward. These hills are structurally like the gneiss hills at Newburgh shown by Berkey, Colony, and others to be floating fault blocks—thrust remnants cut off by normal faulting. Other normal faults break the Schunemunk Mountain block near Monroe and bound the western side of the limestone valley of the Ramapo River at Arden. Steeply dipping transverse faults offset the thrusts and some of the normal faults.

A map is in preparation.

PARAGENESIS OF PEGMATITES WITHIN AND FRINGING THE WHITESIDE GRANITE

BY LOIS KREMER SHARPE*

In the numerous small pegmatites within and fringing the Carboniferous(?) Whiteside granite exposed in southern Jackson and Macon counties, North Carolina, large crystals of perthitic and microperthitic microcline containing two sets of oligoclase blebs lie within a fine-grained groundmass of sodic oligoclase, quartz, and muscovite. Biotite and garnet are fairly abundant, but other common accessories are present only in exceedingly small quantities. Quartz is intergrown with microcline in graphic pattern and is present in feldspar, muscovite, and garnet in irregular tongues, points, and veinlets. Few of the pegmatites have quartz midriffs.

Crystallization followed the "normal order" for pegmatites. Based on the time of maximum crystallization, the sequence of mineral formation was (1) zircon,

* Introduced by J. T. Stark.

biotite, and garnet, (2) microcline, (3) oligoclase, (4) muscovite, (5) apatite, sillimanite, tourmaline, and beryl, (6) quartz—throughout the entire period but in greatest abundance toward the end, (7) garnet, sericite, pyrite, and chalcopyrite. Crystallization of individual minerals overlapped; feldspars, quartz, and muscovite formed simultaneously.

Essential and accessory minerals older than the flood of late quartz are assigned to the late magmatic stage. Abundant myrmekite and symplektitic white mica indicate extensive reaction between the first-formed minerals and deuteric solutions. Passage from pegmatitic to hydrothermal stage is marked by abundant crystallization of late quartz and sericite or its soda equivalent, but no rare minerals were formed. Although most of the minerals of these granitic pegmatites are primary, there has been replacement of microcline by oligoclase; of microcline, oligoclase, and the micas by quartz; and of microcline and oligoclase by late white mica.

UPPER JURASSIC DEPOSITS IN BRAZIL

BY I. G. SOHN*

Surface outcrops of the "Bahia" group in the Bahia Province of Brazil have yielded fresh-water and brackish-water fossils that have been considered by various authorities as Neocomian, Laramie, and Tertiary in age. A collection of core samples ranging in depth from 1915 feet to 2225 feet was examined for ostracodes. These ostracodes were compared with topotype specimens from the Morrison (Upper Jurassic) near Canon City, Colorado, and the Bear River (Upper Cretaceous) 20 miles north of Cokesville, Wyoming. The "Bahia" and the Morrison faunas have several similar species, two of which may be identical, while the Bear River fauna is not closely related to the above faunas. Similarities also were found with the published fauna of the Purbeck beds of England (Late Jurassic). On the basis of the ostracodes it is evident that the part of the "Bahia" group examined is a brackish-water deposit probably of Upper Jurassic age.

IGNEOUS ROCKS OF THE MELCHIOR ISLANDS, ANTARCTICA

BY DUNCAN STEWART, JR.†

A study is made of 131 thin sections of quartz-bearing and intermediate igneous rocks collected by the U. S. Antarctic Service Expedition in the Melchior Islands, and these rocks are compared with those collected by other expeditions from the Palmer Peninsula and its islands. One hundred twenty-one sections are of rocks collected *in situ*. The specimens include leucosodaclase granodiorite, leucogranodiorite, grandiorite, leucogranite, tonalite, diorite, meladiorite, quartz bostonite, dacite, andesite, and diabase. Tables of the quantitative microscopical analyses of the intrusives are presented. The Melchior Islands rocks have Andean affinities and correspond petrographically to other igneous rocks examined from West Antarctica, except that those from the Melchior Islands contain, in practically each instance, twinned hornblende.

ADDITIONAL SPECIES OF THE GENUS *GLOBOTRUNCANA* CUSHMAN

BY HANS E. THALMANN

Species described under different generic names should be placed into the genus *Globotruncana* Cushman, 1927:

* Introduced by John B. Reeside, Jr.

† Introduced by Bradford Willard.

Discorbina bi-concava Parker and Jones, 1862, a reworked form re-embedded in recent shore sands of Melbourne, Australia; *Discorbina stellata* Reuss, 1867, allochthonous in the Salt-Formation of Wieliczka in Galicia; *Discorbina struvei* Mittermaier, 1896, from the Upper Cretaceous of the Tiflis region, Transcaucasia; *Discorbina plano-convexa* Seguenza, 1882, from the Cenomanian of Anconi, province of Reggio, Italy; *Pulvinulina meneghinii* von Hantken, 1884, allochthonous in the Eocene of Scarena and Gorbio, Nice region, France; *Pulvinulina marcellae* de Lapparent, 1918, from the Cenomanian-Turonian of the Béhobie area, French Pyrenees; *Pulivina* (sic!) *guthei* Brotzen, 1934, from the Senonian of Jerusalem and Kison valley in Palestine; *Rotalia elevata* Brotzen, 1934, and *Rotalia concavata* Brotzen, 1934, both from the Senonian of Jerusalem; *Globorotalia ? multiloculata* Morrow, 1934, from the Hartland member, Greenhorn formation (Colorado group) of Kansas; *Globigerina circumnodifer* Finlay, 1940, from the Piripauan stage (Campanian-Santonian) of Whangara, New Zealand (may eventually become the subgenotype of a new subgenus of *Globotruncana*); and "a double keeled *Globigerina*" of M. P. White, 1928 from the Santonian Upson Clay of Texas, apparently identical with *Globotruncana globigerinoides* Brotzen, 1936, from the Santonian of Sweden.

These forms should be added, either as own species or as synonyms, to the already known 18 species and varieties of the genus *Globotruncana,* for use as index fossils for Upper Cretaceous beds.

TEN YEARS OF RESEARCH WORK IN FORAMINIFERA (1931-1940)

BY HANS E. THALMANN

Between 1931 and 1940 the author listed 3443 papers dealing exclusively or partly with Foraminifera recording the following *new* categories: 28 families, 44 subfamilies, 270 genera, 38 subgenera, 3833 species, 674 subspecies (or varieties), 65 novae species (n.sp.), 667 nomina aperta, 55 nomina nuda, and about 250 homonyms.

Of the 308 new genera and subgenera, 65% are described from Cenozoic (29% from Pleistocene and Recent, 36% from Tertiary); Mesozoic and Paleozoic each accounts for 17.5% of the total. Cambrian, Devonian, Liassic, and Pleistocene each yielded 1%, Silurian and Pliocene 3%, Carboniferous and Jurassic 4%, Oligocene 7%, Permian 8%, Miocene 10%, Cretaceous 13%, Eocene 16%, and Recent 28%. None were reported from Triassic.

Of the 4572 new species, subspecies, and sp. nov., 67% came from Cenozoic (19% from Pleistocene and Recent, 48% from Tertiary), 21% from Mesozoic, and 12% from Paleozoic. Less than 1% occur in Cambrian, Devonian, and Triassic, 1% in Silurian and Pleistocene, 2.5% in Jurassic, 3% in Liassic, 4.5% in Permian, 5% in Pliocene, 6% in Carboniferous, 9% in Oligocene, 15% in Miocene, 16% in Cretaceous, 18% in Recent, and 19% in Eocene beds. Cretaceous, Eocene, Miocene, and Recent account for half of the new species and varieties.

Attention is drawn to the relatively meager and imperfect knowledge of the Foraminifera in beds of Cambrian, Silurian, Devonian, Triassic, Liassic, Jurassic, Oligocene, Pliocene, and Pleistocene age. Phylogenetic studies in Foraminifera should, therefore, not be attempted until more is known about the foraminiferal assemblages of these time intervals.

SEDIMENTS OF SMALL, SOFT-WATER, WOODLAND LAKES OF NORTHERN WISCONSIN

BY W. H. TWENHOFEL

The sediments of small, soft-water, woodland lakes of northern Wisconsin have now been studied in more than a dozen lakes. All basins are of glacial origin, and the lakes have areas ranging to more than 1.5 square miles. The shallow-water offshore sediments range from black muds, which are very rich in organic matter and may pass into peat at the shore, to sands relatively free from organic matter, except for pieces of bark and stems, and in a few places to gravels and boulders. Sediments over the lake bottoms to depths of 2 feet or more have been designated sludge but probably should be termed gyttja; they consist of a pale greenish-yellow gel in which are enmeshed tests of diatoms, sponge spicules, bits of organic matter, and particles of quartz and other minerals. The gel composes most of the wet sediments, and the organic matter is usually more than half the dry weight. When seen in quantity the gyttja is greenish or grayish-black, and it is usually more than 90 per cent water. The maximum thickness of gyttja so far found is 42 feet. This thickness is thought to be exceptional, and less than 20 feet is common. Consolidation of the 42 feet would yield less than 4 feet of deposit which would probably be a bituminous shale. The gyttja has a relatively small population of bacteria, and seasonally it is inhabited by the larva of various insects. No stratification of any kind has been observed in the organically rich sediments.

OZARKIAN AND CANADIAN CEPHALOPODS—PART III: LONGICONES

BY E. O. ULRICH, AUG. F. FOERSTE, A. K. MILLER, AND A. G. UNKLESBAY

Long slender straight and slightly curved nautiloids are widespread in the Early Paleozoic of the United States, Canada, and Newfoundland. They appear in the Lower Ozarkian and are abundant in the Upper Ozarkian and the Upper Canadian. A few species are known from contemporaneous beds in Greenland, northwestern Europe, eastern Asia, and probably Australia and South America.

Externally most of the American forms are similar, though some are smooth, and others are annulated. Chiefly on the basis of the figure of the conch, the nature of the surface, the shape of the sutures, and particularly the structure of the siphuncle they have been divided into 11 families: the Stemtonoceratidae (3 species representing 2 genera), the Basslerocerati dae (41 species, 10 genera), the Orthocerotidae (20 species, 7 genera), the Robsonoceratidae (2 species, 1 genus), the Spyroceratidae (29 species, 3 genera), the Endoceratidae (70 species, 9 genera), the Suecoceratidae (3 species, 1 genus), the Bathmoceratidae (1 species, 1 genus), and three unnamed families (5 species, 2 genera; 8 species, 3 genera; and 1 species, 1 genus; respectively). All but four of these families are represented in both the Ozarkian and the Canadian, and these four contain only a few aberrant forms.

EOCENE LARGER FORAMINIFERA FROM BARBADOS, BRITISH WEST INDIES, AND A CATALOGUE OF THE AMERICAN SPECIES OF THE DISCOCYCLINIDAE

BY THOMAS WAYLAND VAUGHAN

Dr. Alfred Senn sent me for study the larger Foraminifera he collected from the Joes River mud flows and the larger Foraminifera and corals from the Scotland formations of Barbados. He has supplied stratigraphic data as follows:

Upper Scotland formation	Mount All member	Lower Scotland formation	Morgan Lewis member
	Chalky Mount member		Walkers member
	Murphys member		
		Joes River mud flows	

The foraminiferal fauna here considered comprises the families Orbitolinidae, Camerinidae, Discocyclinidae, Asterigerinidae, and Orbitoididae; 6 genera (1 new); and 20 species (12 described as new).

The Joes River mud flows have been correlated by Vaughan and Cole with the Soldado formation of Soldado Rock, Trinidad. The Lower Scotland formation contains few species. The Upper Scotland, although its fauna is mostly peculiar, seems to be definitely Claibornian middle Eocene. The organisms lived in shallow warm water but were not littoral.

The predominance of species of Discocyclinidae in the Barbadian Eocene prompted restudy and classification of all American species of the family. Including the 10 new names proposed in the paper on Barbados and the 3 or 4 new ones in the catalogue, about 80 names have been applied to American members of the family. The features of the equatorial chambers were ascertained for every form except one, and those of the embryonic chambers for all forms except 8, and for several species the intraseptal and intramural lumina were studied and described. The stratigraphic and geographic occurrence of each form is given in a table. The range in age is from the lower Eocene or Paleocene upper Midwayan to the upper Eocene Jacksonian.

SCLERACTINIAN CORALS FROM THE EOCENE UPPER SCOTLAND FORMATION OF BARBADOS AND THE MIOCENE OF MARTINIQUE

BY JOHN W. WELLS

The scleractinian corals of the Chalky Mount member of the upper Scotland formation occur at several horizons throughout the member but are considered as a single collective fauna consisting of 25 species and 1 variety, representing 22 genera and subgenera and 10 families. Fifteen species and 1 variety are new; 2 of the genera are new. Two species are identified with, and 1 is referred to, previously described species. Seven can only be generically determined at present but are probably new. The fauna is a mixed assemblage of hermatypic and ahermatypic forms indicating an environment different from that of other West Indian Eocene coral faunas and similar to that of the Middle Eocene of the U. S. Coastal Plain area—tropical shallow-water but not littoral, at or somewhat beyond the lower limits of depth and temperature for vigorous reef-coral growth. In line with this the relationships of the fauna, although most of the species are new, are with those of the Coastal Plain Eocene rather than with the more exclusively hermatypic faunas of the West Indian Eocene. Only 1 species has West Indian affinities, whereas at least 10 are related to Coastal Plain forms. Two turbinolian corals from the Miocene Bassignac tuffs of Martinique are described. One is a new species of *Sphenotrochus (Eusthenotrochus)*, the first record of this subgenus in the American Tertiary; the other is *Dominocotrochus dominicensis* (Vaughan), hitherto known only from an uncertain but probably Miocene horizon in the Dominican Republic.

CAMBRO-ORDOVICIAN OF THE SOUTHWEST

BY R. R. WHEELER

Study of the El Paso limestone of trans-Pecos Texas and New Mexico in exposures in the Franklin Mountains and Diablo Platform and in intervening subsurface tests permits the following revision:

1) Upper 300 feet of El Paso contains Middle Ordovician fossils with Chazyan affinities and lies disconformably upon Lower Ordovician with diagnostic Ellenburger and Beekmantown faunas.

2) Underlying (restricted) El Paso formation consists of upper (limestone) and lower (dolomite) members.
3) *Lecanospira, Eurystanites,* and asaphids in upper El Paso indicate upper Beekmantown (Cassin) age. Two species of *Ophileta* and *Eccyliopterus* permit correlating lower El Paso with lower Beekmantown (Tribes Hill formation of New York) recently shown by the writer to contain the Gasconade fauna of Missouri and Central Texas.
4) Although King (1940), following Bridge's restudy of fossils from the Bliss sandstone beneath the El Paso, referred the Bliss to Lower Ordovician, the writer assigns it to Upper Cambrian because:
    a) The Bliss was said to contain the *Ophileta* fauna (previously noted as considerably above the base of the succeeding El Paso formation). This is difficult to accept because of the narrow range of the *Ophileta-Eccyliopterus-Hystricurus* zone elsewhere, especially since King and others regard the El Paso as disconformable upon the Bliss.
    b) Except for *Scolithus* tubes, the type Bliss contains only brachiopods, which Walcott identified as Upper Cambrian. One—*Lingulella acuminata*—occurs in the Potsdam and Theresa of New York beneath later Upper Cambrian strata.
5) Thus, it no longer seems justifiable to assume absence of Middle Ordovician in trans-Pecos Texas or absence of early and middle Beekmantown faunas due to erosion or nondeposition between the Bliss and El Paso, or, finally, that there is no record of an Upper Cambrian marine invasion (in spite of the thick Upper Cambrian section in the Central Mineral Region and Marathon Basin to the east).

Geological Society project.

ILLINOIAN AND WISCONSIN DRIFT OF THE GRAND RIVER LOBE IN EASTERN OHIO

BY GEORGE W. WHITE

The boundary of the Wisconsin drift of the Grand River lobe in eastern Ohio extends westward through Columbiana and Stark counties from a point on the Ohio-Pennsylvania State line 1 mile south of East Palestine, through Rogers, Lisbon, New Alexander, East Canton (Osnaburg), to the northwestern part of Canton, where the southward-trending border of the Killbuck lobe joins, or possibly overlaps, it. South of the Wisconsin boundary, drift older than Wisconsin is present in a belt 2 to 5 miles wide. The amount of erosion and the depth of weathering of the older drift are similar to those of the Illinoian drift area on the east side of the Scioto lobe in east-central Ohio, and this older drift of the Grand River lobe is therefore correlated as Illinoian. The Illinoian boundary is parallel to the Wisconsin boundary, being 5 miles south at the State line, 2 miles south at the Columbiana-Stark county line, and 5 miles south at Canton, where the Wisconsin drift of the Killbuck lobe overlaps the Illinoian belt.

The Wisconsin till is continuous and thick. It is leached to a depth of 5 to 6 feet and oxidized to a depth of 7 to 9 feet. The Illinoian till is very discontinuous and thin. The area of older drift is much further advanced in the erosion cycle than is the Wisconsin area. Unaltered Illinoian till is rare, but calcareous till is sometimes present at depths of 8 to 10 feet. Geological Society project.

CORDILLERAN SECTION MEETING AT CALIFORNIA INSTITUTE OF TECHNOLOGY IN APRIL

IGNEOUS FEATURES OF JUNIPER RIDGE, OREGON

BY JOHN ELIOT ALLEN *

A part of Juniper Ridge adjacent to the Squaw Butte Ranch, in Harney County, Oregon, discloses extrusive or shallow-intrusive masses of igneous rock with internal structures so complex that all features could not be mapped at a scale of 1000 feet to the inch. These features were studied in an area of about a square mile in sec. 36, T. 23 S., R. 25 E., and sec. 1, T. 24 S.

Rocks of five igneous types, all closely related, were discriminated in the mapping:

Porphyritic obsidian, light-gray; mostly as float.
Porphyritic obsidian, red; as dikes.
Perlitic obsidian, largely black but red in part, lithophysae abundant at many places; as small lenses.
Porphyritic andesite, gray or red and gray in fine bands; commonly has platy parting between bands, which are contorted at places.
Porphyritic andesite, dark-gray to reddish, massive, lithophysae abundant at many places.

Flow banding in and lenses of the above types of rock may vary rapidly in attitude within tens of feet; in a few places the finely banded phase is so contorted that attitudes could not be plotted on the scale used. Similar sequences of rock types occur in several sections, which, together with centripetal dips of flow banding, are interpreted in two localities as indicating centers of plug dome intrusion, fan-shaped in cross section.

The original volcanic extrusive structures were eroded to produce a fairly level surface. Four northwest-southeast trending splinter faults broke this surface, with the downdropped side of each fault to the north and vertical displacements of 50 to 250 feet.

RECORD OF THE TERM "CHICO GROUP" IN GEOLOGIC LITERATURE

BY FRANK M. ANDERSON

The use of the term "Chico Group" as a formational name began with W. M. Gabb in 1868. As defined by Whitney (1869), the name was intended to cover all Upper Cretaceous strata in California and Oregon and on the West Coast. This term as then defined needs but little alteration now to fit well the major geologic facts and the historically accepted usage of most authoritative writers.

As defined by Whitney no "type locality" or *type section* was given for it, and, in fact, none could be given, since as stated by him (p. xiv) it included:

"all of the known Cretaceous of Oregon and of the extreme northern portion of California, and the coal-bearing formation of Vancouver Island".

Gabb continually employed the term "Chico Group" in such inclusive sense in all his stratigraphical references to which he thought it applicable.

Its known thickness (28,000 feet) and its natural division into groups and formations at the present time require the use of the term "Series", rather than "Group"

* Introduced by Charles A. Anderson.

for it, and this interpretation has been implied in the usage of most writers since 1900. The first formal use of the term "Chico Series" thus far found in the literature was by Chamberlin and Salisbury (1907, vol. 3, p. 160). This inclusive use of the Chico is expressed or implied in all publications of the State and of the National Survey since the turn of the century, as found in a candid review of the literature. No "type locality" for this "Group" (series) exists.

GOUGE IS NOT POSITIVE FAULT EVIDENCE

BY JOHN P. BUWALDA

The presence of gouge is commonly regarded as quite conclusive evidence that an observed fracture in rock is a fault rather than a joint. This reasoning is usually correct, but it is frequently desirable to determine positively whether a fracture is a fault or a joint; in mine mapping it is important because of the possible difference in effect on veins cut by the fracture, and in engineering excavations for dams, tunnels, deep cuts, and other structures the effect of the two types of fractures on stability and bearing strength may be very different.

Fractures in old crystalline rocks have been observed which are filled with gouge up to 2 inches in width but which have suffered no movement parallel to the walls, as indicated by absence of slickensides, by opposed projections and indentations, and by alignment of small veins or aplite dikes. The wall rock is fresh and did not produce the gouge by decay. In one case bright red gouge from a rather flat near-surface fault fills virtually all joints for a depth of at least 75 feet below it. The gouge was apparently carried down by meteoric water. In other cases joints have been filled with soft gouge up to distances of several tens of feet from a near-by fault, apparently by flowage under tectonic forces.

The phenomenon indicates that sole reliance cannot be placed on gouge in careful discrimination between minor faults and joints.

USE OF FOSSIL FISH SCALES IN MICROPALEONTOLOGY

BY LORE R. DAVID *

Fossil fish scales are abundant in the marine Tertiary rocks of California and occur throughout the Miocene, in the Oligocene, Eocene, and Upper Cretaceous. All specimens are too large to be washed out with foraminiferal samples. Fish scales are well preserved at many localities, especially in sediments of neritic or abyssal origin. Taxonomic features are supplied by apical and basal poles, shape and structure of circuli, nucleus, basal or transverse radii, and marginal spines. These characters permit generic and to some extent specific determination.

Some groups of fishes, especially the herringlike fishes, are extremely abundant. Specific forms change with time. These can be used as indicator fossils and are likewise useful in correlations involving small time units.

Fish scales are sufficiently large to be observed with a hand lens and can therefore be identified in the field. Since fossil fishes give specific information regarding bathymetric zones and climate, scales aid the geologist in comprehending ecological factors during deposition and former position of shore lines.

* Introduced by Chester Stock.

Slides are shown of scales characteristic of different stages. Mohnian scales have been studied in outcrops at the type locality, Girard-Mohn Springs; Middle and Lower Miocene and Oligocene scales have been studied from core samples from the San Joaquin Valley.

GEOMORPHIC UNCONFORMITY

BY MAURICE DONNELLY *

At numerous places in the United States, land forms of the third order of magnitude show a tripartite relationship in which an upper surface of little relief is separated from a lower surface of little relief by a steep and dynamically unstable surface. This relationship is termed "geomorphic unconformity." In the genesis of the geomorphic unconformity, a surface of little relief is first sculptured. A change interrupts the geomorphic cycle in which this first surface was produced. Following this change two new surfaces are formed: a lower-lying surface of little relief, and a steep interconnecting surface, here called the "critical slope." A diagnostic feature of the geomorphic unconformity is that, in conditions undisturbed by man, much of the runoff from the upper surface moves by unconcentrated overland flow down the critical slope. Because of the instability of the critical slope, it is the scene of gullying, especially of agriculturally induced gullying. Many of the agriculturally induced gullies described in the literature may be termed "critical-slope gullies" because they originated on critical slopes. The geomorphic unconformity is obliterated when the critical slope has been destroyed. Theoretically, geomorphic unconformity may exist in land forms of the second order of magnitude.

LOWER MIOCENE IN THE WILLAMETTE VALLEY, OREGON

BY J. WYATT DURHAM, HERBERT HARPER, AND BEVERLY WILDER, JR.†

Tuffaceous sandstones, pebble conglomerates, and impure shell limestones of shallow marine deposition have been mapped in the vicinity of Butte and Abiqua creeks in the southern half of the Molalla quadrangle, about 30 miles south of Portland, Oregon. The base of the sediments is not exposed so that the total thickness and their relation to older rocks are unknown. They are overlain unconformably by the Stayton lavas in the western part of the area, whereas to the east they are interbedded with and in part overlain conformably by terrestrial volcanic sediments. Dips average about 6° and indicate an elongate domal fold trending northeast-southwest.

Examination of a supposedly Oligocene molluscan fauna from these beds indicates definitely that they are lower Miocene in age. Among the fossils are *Spisula albaria, Spisula cf. catilliformis, Tellina oregonensis,* and *Pecten sespeensis.* On the basis of *P. sespeensis* it is considered most likely that the beds are equivalent in age to the Vaqueros formation of California. This is the first fauna found north of central California which resembles that of the Vaqueros. It is possible that the marine sediments were laid down in the initial stage of the Miocene Astoria seaway which probably entered the Willamette area from the north or northwest.

Florules representing the same flora have been collected from the base to the top of the exposed terrestrial sediments. A comparison of this flora with other Pacific Coast Tertiary floras indicates a lower Miocene age. It most closely resembles the temperate Eagle Creek flora, also of lower Miocene age.

* Introduced by Ian Campbell.

† Introduced by B. L. Clark.

ANDESITE BRECCIA DIKES NEAR BLAIRSDEN, PLUMAS COUNTY, CALIFORNIA

BY CORDELL DURRELL *

Hornblende andesite breccia dikes intrude andesite mud flows and lava near Blairsden, California. The dikes consist of blocks of andesite in a mudlike matrix very similar to the mud flows which they intrude. Normal green hornblende in the dikes, in contrast to basaltic hornblende in the mud flows, and certain alteration features indicate that the dikes are composed of new magmatic material and are not reinjected mud-flow material.

It is concluded that steam is the agent of brecciation and that this took place at comparatively low temperature.

In the eruption of the breccia to the surface the erupted material was probably saturated with water. It is suggested, therefore, that such eruptions from large numbers of these now inconspicuous dikes may have constituted the source of the mud flows of the Sierra Nevada.

METAL-PRODUCING AREAS IN THE WESTERN STATES

BY HORACE J. FRASER

The 11 Western States together constitute the major domestic source of many essential metals. Virtually all our domestically produced chromite, molybdenum, tungsten, vanadium, and uranium are obtained from these States; about 90 per cent of our copper, mercury, and silver, 70 per cent of the gold, about 50 per cent of the lead, and 35 per cent of the zinc also come from there. The production of some of these metals is from a few districts, while others come from many sources. The characteristic occurrences of each metal and the location of its important deposits are briefly reviewed. The current production from various areas is graphically presented with comments on possible future trends.

EARTHQUAKES AND STRUCTURE IN SOUTHERN CALIFORNIA

BY BENO GUTENBERG

Investigations based upon seismograms of 50 southern California shocks since 1933 have led to the following conclusions:

(1) Most larger shocks have occurred in a few small areas near major faults. In each group, successive epicenters are distributed over subparallel branches as well as along the major faults.

(2) Direction of fault slipping agrees with previous findings by the author; improved location of epicenters has reduced discrepancies. In all of seven shocks in northern Owens Valley the eastern block has moved relatively southward.

(3) Travel times and velocities correspond closely to those found previously for southern California. Most shocks have originated near the bottom of the "granitic layer" (depth 18± km.). A few foci under the Santa Ana Mountains were in deeper crustal layers.

(4) The deepest "continental" layer extends to an average depth of about 40 km. to the west of the San Bernardino Mountains and roughly 10 km. deeper southeast of them. The greatest thickness found is beneath the Sierra Nevada near northern Owens Valley (bottom at a depth of at least 60 km.). This "root", suggested by Byerly, obstructs and delays the Pn-waves traveling through the subcontinental layer to moderate distances. Such delay decreases from the Mammoth region toward the south; it is negligible under the Tehachapi Mountains and in southern Owens Valley but is relatively large under northern Owens Valley. Waves transmitted through

* Introduced by James Gilluly.

the upper crustal layers only do not show noticeable delay in any of the localities mentioned above. This indicates relatively less relief of the surfaces separating the upper layers.

WALLOWA BATHOLITH

BY KONRAD KRAUSKOPF *

In the Wallowa Mountains of northeastern Oregon is a batholith of granodiorite and quartz diorite intrusive into Triassic sedimentary rocks and overlain by Columbia River basalt. Good exposures permit detailed examination of a large part of the batholith and its contacts. Petrographic uniformity of the granodiorite indicates that the batholith is a single intrusive mass. It is largely structureless, the only mappable structure being a faint peripheral foliation usually approximately parallel to the contacts. Most contacts dip steeply away from the intrusive and are discordant in detail. Contacts are sharp, except for occasional patches of intrusive breccia showing transitional types between metamorphic and igneous rocks. Pegmatite, aplite, and lamprophyre dikes are not common but are abundant locally. Along the contacts high-grade thermal metamorphism is superposed on an earlier dynamic metamorphism, giving faintly foliated hornfels, quartzite, marble, and lime-silicate rocks. Intensity of metamorphism varies somewhat with the nature of the contacts. Xenoliths are common only locally, especially where pegmatite is abundant. Ore minerals along the contact include chalcopyrite and molybdenite with a little scheelite, galena, and sphalerite; these are found only at limestone contacts where pegmatite is abundant. Gold-quartz veins are found only at one locality.

In general, the batholith is structurally and petrographically remarkably simple. It has several distinctive and recognizable characteristics, but these characteristics show considerable local variation.

COAL MEASURES AND RED-BED SECTION OF NORTHERN SZECHUAN, CHINA

BY GEORGE D. LOUDERBACK

As known since the days of Von Richthofen, a sequence of coal-bearing strata and red beds lie to the south of the Paleozoic formations of the Tapa Shan, dipping into the Red Basin of Szechuan with gradually decreasing dips. A detailed section indicates a greater thickness (approximately 15,000 feet) than previously estimated on the basis of rapid reconnaissance traverses. The total for the Red Beds (12,896 feet) is much greater than that of measured sections in the central part of the basin (4117 feet) and remains so, even if a generous allowance is made for possible removal by erosion. Furthermore, conglomerate and conglomeratic members total over 5000 feet in the northern section, while they form only a few insignificant layers in the central basin. This is interpreted to indicate diastrophic disturbances that caused elevations in the mountains to the north, from which the great bulk of coarse detritus was derived, and corresponding depression of that part of the basin in front of the mountain uplifts.

Diagnostic fossils have not been found to date the various events satisfactorily. In the Red Beds the scattered fresh-water molluscs are not very informative. The coal measures are usually called Jurassic, although their fossil plants have often been referred to the Rhaetic. Dr. C. B. Read has studied the plant remains from several localities and favors an upper Triassic age. In the lowest coal horizon marine invertebrates were found in association with the plants. Dr. T. W. Stanton considers them definitely Triassic.

* Introduced by A. C. Waters.

CAMBRIAN SEDIMENTATION IN NORTHERN ARIZONA

BY EDWIN D. MCKEE

The relation of time planes to lithogenetic units and of the association and sequence of facies within definite time zones in the Cambrian sediments of the Grand Canyon has been studied in detail. Numerous widespread fossil beds, thin but persistent conglomerate zones, and horizons of distinctive lithology are reliable as key beds and have made possible the tracing of various units along the excellent and practically continuous exposures of the canyon walls. The fauna is being studied by Charles E. Resser.

Time planes which cut diagonally across lithogenetic units give a measure of the rate of transgression and regression. Other evidence indicates that the Cambrian sea advanced by a series of rapid and extensive movements, after each of which it remained relatively stable and accumulated uniform sediments for a long period. Between some of the advances were times of temporary retreat, which also were relatively rapid and were followed by extended periods of uniform environment. During each transgression essentially the same sequence of facies was developed from the open sea to the shore, but during times of regression a different sequence resulted. Furthermore, certain lithologic types were developed only during periods of transgression, others only during regressive stages.

Periods of widespread advance by the Cambrian sea are believed to have been inaugurated by rapid sinking of the basin; those of regression by slower sinking or cessation. During regressions deposits built up to or near the base level of deposition, causing detrital sediments to advance seaward.

GEOLOGIC FEATURES AS BASES OF MAJOR CONCEPTS IN PUBLIC EDUCATION

BY JOHN C. MERRIAM

Democracy requires that we be trained to think in terms of great concepts and accustomed to examination of broad fields of thought in such manner as to form reasonably satisfactory judgments. It is essential that in the thought of each person there be picturing of certain realities representing what we might call major concepts that may set standards or patterns for thought. Once habits of thinking are developed in which there is adjustment to values of broad concepts, one may expect utilization of other concepts in such manner as to determine standards of thought or lines of thinking.

In study of the greater values to be derived from outstanding natural features, frequently these values are expressions of what may be called major concepts in science. So, in viewing a mountain range, one may be impressed by the tremendous power involved in the uplift and shaping of the range. The huge masses of material that have been elevated and broken make us aware both of the forces involved and of the laws by which they operate. Collectively such features in nature give us a concept of activity which may be called great, and the greatness of this expression we recognize as a source of inspiration.

FOLIATED DIKES AND PSEUDO DIKES

BY WILLIAM J. MILLER

Many foliated dikes and pseudo dikes, mainly in southern California, show need for criteria distinguishing dikes from xenoliths. Foliated dikes may be easily mistaken for xenoliths, and many xenoliths closely resemble dikes. Particularly deceiv-

ing are certain long, narrow, straight xenoliths which, upon casual examination, would be called dikes. Criteria for making the distinctions are proposed.

Many of the foliated dikes are in or near fault zones produced by shearing stresses long after the emplacement of the dikes—*e.g.*, Tertiary dikes foliated by Quaternary stresses. Consideration is given to the direction of application of such stresses. In some of the dikes the foliation is primary.

Foliation of the pseudo dikes may or may not have resulted from stresses developed during faulting.

RECENT APPLICATIONS OF PETROGRAPHY TO THE STUDY OF CONCRETE DISINTEGRATION

BY ALLEN H. NICOL*

Recent researches by California State Division of Highways, U. S. Bureau of Reclamation, and others are throwing light on composition of concrete that has disintegrated.

Some disintegration is due to reaction between certain aggregates and alkalis in cement. Compounds of sodium and of potassium form hydroxides. Research on California aggregates indicates all types tested containing opal react with high-alkali cements. Other minerals related to opal are under observation. Aggregates from the country at large show andesite, felsite, rhyolite, chert, and phyllite to be highly suspicious. The reactions involved and the reactive mineral phase of these aggregates are under investigation.

Disintegrative reactions involving high-alkali cements generally produce pop-outs, extrusion of "gel", and cracking accompanied by expansion of the concrete. Detection and identification of reactive rocks is complex. Methods used involve fluorescence, petrographic study of thin sections and polished surfaces, sealed curing tests, chemical analyses of rocks and extruded gels, and studies of synthetic minerals and rocks. Petrographic methods may be used to control new aggregates for construction.

These methods utilize treatment by dyes, specific-gravity separation of opal in sands, weight loss by soaking in alkaline solutions, accelerated sodium sulphate and magnesium sulphate soundness tests, abrasion tests, autoclave tests, and accelerated expansion tests of mortar bars.

RE-EXAMINATION OF HIBSCHITE

BY A. PABST

X-ray examination of hibschite from the type locality, near Aussig, Bohemia (material kindly loaned by Doctor Foshag of the National Museum), shows that this material has a garnetlike structure. Since this suggests that it also has a garnetlike composition it seems that hibschite is probably not a dimorph of lawsonite as hitherto supposed. These results support the conclusion of Belyankin and Petrov that hibschite and plazolite are identical or nearly so.

STRUCTURES IN PROLONGATION OF THE SAN ANDREAS FAULT ZONE

BY FRANCIS P. SHEPARD

Previous work has shown that the rifts developed at Shelter Cove near Point Delgada at the time of the San Francisco earthquake can be traced into a fault zone extending along the coast to the north and out onto the continental shelf. Further continuation is shown by a beheaded submarine canyon and some rift cracks leading

* Introduced by Ian Campbell.

to a tremendous escarpment which curves to the west and extends out to sea for at least 60 miles and possibly for several thousand. Evidence favors a dominant horizontal movement along this probable northward continuation of the San Andreas rift.

To the south the continuation of the San Andreas fault zone was indicated in 1940 by a horizontal shift of 15 feet in the floor of Imperial Valley. Prolongation of this line of movement reaches the Gulf of California. Although no evidence has been discovered in the Gulf to indicate horizontal shifting, indirect evidence suggests rotational forces of the kind assumed as a cause for the San Andreas fault. A series of basins along the length of the Gulf have a zigzag pattern. These basins are comparable in size and depth to the deepest lake basins in the world. The V-shaped cross sections found in many places contrast with the trough shape of typical fault basins on land and may be the result of horizontal shifting. The deeps of the Gulf are comparable to fault basins and troughs off the California coast and in the West Indies.

GEOLOGY OF HORSE HEAVEN MINE

BY LLOYD W. STAPLES *

The Horse Heaven mine is situated in Jefferson County in central Oregon. It was discovered in 1933 and has become one of the nation's major producers of quicksilver. The deposit is principally in tuffaceous beds of the Clarno formation, but major chutes have also been found in an intrusive basalt and in a large clay (montmorillonite) body probably representing an alteration of the tuffs.

Cinnabar and mercury are the only ore minerals. Metacinnabar and calomel are rare. Marcasite is the principal metallic gangue.

The chief structural feature of the mine is the Horse Heaven fault which acts as a structural trap and places the mine in the class of "conventional" mercury deposits. Ore has been mined on nine levels under this fault, which strikes N.35°W. and dips about 40° SW. Although development under the fault has led to the discovery of most of the ore, several large and high-grade bodies have been found away from the fault, where the concentration has depended on other structural features.

The Horse Heaven mine is uncommon among quicksilver mines in that most of the ore bodies have been found by a study of structure rather than by following stringers or "staying with the ore". Magnetometer and electrical resistivity methods have proven very helpful in structural studies.

CAVE OF SAN JOSECITO, NUEVO LEÓN, MEXICO

BY CHESTER STOCK

A large fissure deposit in Mesozoic limestone near San Josecito in southern Nuevo León, at an elevation of 7400 feet, has yielded a diversified assemblage of mammals and birds. The osseous material apparently accumulated with progressive sinking of the cave floor. The cave deposit is more than 70 feet thick. The vertebrate assemblage includes a number of elements found in the brea beds of California and is late Quaternary in age. More than 80 species of mammals and birds are now known from this deposit. Among the most common mammals are the extinct antelope (*Stockoceros*), a large deer (*Odocoileus*), horse (*Equus*), and ground sloth (*Nothrotherium*). Camels are extremely rare, and the Proboscidea are absent. The fauna aids materially in delineating the southerly range of genera and species described from the Pleistocene of the United States.

* Introduced by W. D. Smith.

REVISION OF THE PERMO-TRIASSIC SEQUENCE AT DJULFA, ARMENIA

BY ALEXANDER STOYANOW

This paper revises the writer's original description of the Permo-Triassic sequence near Djulfa, Armenia, published over 30 years ago. Exposed in the narrow gorge of the Araxes on the Russian-Iranian border, 100 miles southeast of Mount Ararat, the Djulfa section is one of the principal localities, widely scattered between the Alps and Timor, for interpretation of the Permian-Triassic succession within Tethys. Critically revised are: (1) the writer's original postulations of an Early Permian age of the Paleozoic part of the section, which was based on cephalopods closely related to certain forms of a much older habitus (Tschernyschew, Stoyanow, Spath), and of the nature of the nonsequential succession in the overlying Triassic strata; (2) Bonnet's placing of the *Meekoceras-Hedenstroemia* strata (*"Pseudosageceras multilobatum* subzone" of J. P. Smith) above the *Stephanites-Paratirolites* zone (*"Anasibirites* subzone" of J. P. Smith), and assumption of the post-*Prototoceras* age of *Pseudogastrioceras abichianum;* (3) J. P. Smith's (posthumous work) placing Djulfa on the Caspian Sea and the *Paratirolites* fauna in the Himalayas. During the first World War the writer briefly revisited Djulfa and believes he established the *Meekoceras-Hedenstroemia* zones in the lower part of the Triassic division, close to the *Popanoceras tschernyschewi* zone. The break in the sequence, therefore, is to be sought above the latter zone. The nomenclature of the involved paleontological assemblages is revised and brought up to date.

FELDSPAR PHENOCRYSTS OF THE COTTONWOOD GRANODIORITE, UTAH

BY BRONSON F. STRINGHAM *

The typical Cottonwood Granodiorite is light gray, granitoid, medium to coarse grained, and massive. It occurs in the Wasatch Mountains near Salt Lake City as a stock of moderate size. Feldspar phenocrysts are scattered throughout much of the body, and in one small apophysis to the north they weather out and are obtainable in considerable numbers. These were used for this study. The crystals are well developed with the usual faces (001), (010), (110), (201), (111), present and elongated parallel to the *a* axis. They vary in size from 1 to 16 cm in length. Carlsbad and Manebach twins are frequent. The crystal surfaces are spotted and rough due to the adherence of fragments of the groundmass. Thin sections show that they are microcline-microperthite with innumerable inclusions of oligoclase, quartz, hornblende, biotite, sphene, and apatite, usually oriented at random but occasionally distributed in zonal arrangement.

Several islands of quartz with unit extinction, embayed oligoclase, and other replacement relations between the inclusions and microcline together with replacement structures at the border of the crystals strongly suggest that these phenocrysts developed very late in the magmatic history of the rock, perhaps after all other constituents had formed.

MANGANESE DEPOSITS OF THE COAST RANGES AND SIERRA NEVADA

BY N. L. TALIAFERRO

The manganese deposits of both the Coast Ranges and Sierra Nevada are always associated with radiolarian cherts; volcanics are nearly always present. They are syngenetic deposits interbedded with or grading into cherts. Those in the Coast

* Introduced by Hyrum Schneider.

Ranges occur in the Franciscan (late Upper Jurassic) and are, as a rule, little altered except by oxidation; those in the Sierra Nevada occur with both Paleozoic and Jurassic sediments and volcanics and frequently are highly metamorphosed. The original manganese-bearing cherts and ores have been oxidized at the surface, the oxidized zone varying from a mere film to as much as 100 feet, depending on the local physiographic history and the extent of jointing and faulting. Beneath the oxidized zone the primary ore consists either of manganese carbonate, neotocite, or a mixture of the two. Neotocite is a liver-brown manganiferous opal with the general formula $x\ MnO_2 \cdot y\ SiO_2 \cdot z\ H_2O$. When unaltered it is isotropic and was, originally, a colloid. All gradations between chert, manganiferous chert, and neotocite occur. Iron is nearly always present and may exceed the manganese. In a few cases Radiolaria have been found in neotocite.

In the Sierra Nevada the primary ores, beneath the oxidized zone, have been somewhat recrystallized by dynamic metamorphism; on granodiorite contacts they have been recrystallized to spessartite-rhodonite-quartz schists.

Some of the completely oxidized ores are of high grade, as are some of the purer carbonate ores; the neotocite ores are usually high in silica and of low grade.

TERTIARY FORMATIONS AT COOS BAY, OREGON

BY CHARLES E. WEAVER

The Coos Bay region of the Oregon coast is one of several critical areas in the stratigraphy and paleontology of the Tertiary formations of western North America. It contains the type sections of four described Tertiary formations—the Arago (late Eocene), the Bassendorf shale and the Tunnel Point sandstone (early and middle Oligocene), and the Empire formation (Pliocene).

These marine strata lie within the flanks of a northwestward-plunging syncline whose axis trends along South Slough. The Arago formation between Cape Arago and Yokam Point consists of approximately 8400 feet of marine interstratified clay shales, sandy shales, shaly sandstones, and sandstones in units ranging from a few inches to 200 feet thick. Sandstones are more abundant in the lower and middle parts of the formation.

The Bassendorf formation, slightly unconformable on the Arago, consists of 2400 feet of marine thinly bedded sandy shales which pass upward into massive brittle tuffaceous shales. The Tunnel Point sandstone is approximately 760 feet thick with a slight unconformity at the base and a strong unconformity at the top. It is composed of nodular massive sandstone becoming somewhat laminated near the middle and passing into interbedded shales and sandstones near the top. The Empire formation is 1540 feet thick consisting of massive sandstone in the lower part and nodular sandstone above with the Coos conglomerate as an intercalated stratigraphic unit in the upper part.

RECENT DRAINAGE CHANGES IN TOOWA VALLEY, SOUTHERN SIERRA NEVADA

BY ROBERT W. WEBB *

A broad east-west mature valley, named Toowa Valley by Lawson in 1904, lies astride the Sierra Nevada in latitude 36° 22′ N., west of Olancha, California. The valley is drained by Golden Trout Creek, which flows west, and the South Fork of the Kern River, which flows east. Both streams enter Toowa Valley from the north.

* Introduced by James Gilluly.

Here, the divide separating them is only 25 feet high and 150 feet wide. Small volcanic outbursts have produced temporary base levels along the west-flowing stream, and several west-draining tributaries have been successively captured by the east-flowing stream. If the present base levels are maintained, further capture of west by east drainage is imminent. If, however, accelerated downcutting by the west-flowing stream cleanses its channel of volcanic material, the entire drainage will soon be returned, through a series of future captures, to a pattern similar to the original. Evidences for these captures are (1) cobbles along the line of former stream channels, (2) underfit streams in present valleys, and (3) anomalous drainage pattern of tributaries in the two major stream systems.

VOLCANOES OF THE THREE SISTERS REGION, OREGON CASCADES

BY HOWEL WILLIAMS

During the Pliocene an arcuate cluster of basaltic and basaltic andesite shield volcanoes was built in the Three Sisters region. Included in the cluster are the North Sister, Little Brother, Husband, Wife, Sphinx, and Broken Top, the radial dikes and conduit fillings of which have been bared by glacial erosion. The view that this line of peaks marks the rim of a caldera formed by decapitation of an enormous central volcano—Mount Multnomah—is shown to be erroneous. During the Pleistocene, andesites and dacites were erupted, principally by the Middle and South Sisters, while new basaltic cones were growing elsewhere. During Recent time, still other cones of basaltic lava and scoria were formed, and vast flows were poured from some of them, notably from the Belknap Craters near McKenzie Pass, while showers of dacite pumice and viscous domes of obsidian were erupted by neighboring vents. Some of these eruptions ended only a few centuries ago; nowhere in the High Cascades has there been more volcanic activity within the last millennium. Taken as a whole, the magmatic history closely resembles that of the Crater Lake region and the post-Miocene activity of other parts of the Cascade Range farther south.

ABSTRACTS OF THE PALEONTOLOGICAL SOCIETY

DECEMBER MEETING AT OTTAWA (CANCELED)

ANOTHER SKULL OF *PROLACERTA*

BY CHARLES L. CAMP

Prolacerta, described in 1935 by Parrington, is represented in the University of California collections by a complete skull, cervical vertebrae, and ribs, from the Lower Triassic of South Africa. Parrington's view that this eosuchian approaches the ancestry of the lizards can be confirmed. The lower temporal bar consists of a slender process of the jugal which just fails to reach the quadrate. There is a remnant of a "quadratojugal." The vertebrae are amphicoelous with cervical intercentra. No osteoderms are preserved, and since there are no traces of them over the skull it does not seem that Broom's explanation of the cause of disappearance of the posterior process of the jugal in lizards can be supported. Nevertheless Broom's suggested derivation of lizards from Eosuchia is clearly indicated by this specimen.

SEQUENCE OF VERTEBRATE FAUNAS IN THE PRE-TERTIARY OF THE SOUTHWEST

BY CHARLES L. CAMP

Beginning with the Upper Devonian of central Arizona, there is a succession of beds in which vertebrate remains occur. The Lower Permian (Abo-Supai-Cedar Mesa); the upper Lower Permian, possibly "Middle" Permian (Coconino-Kaibab); the Lower Triassic (Moenkopi) with an abundant rhachitomous amphibian fauna; the Upper Triassic (Chinle); the Lower Jurassic (Wingate and Navajo) with earliest crocodilians and several carnosaurians; the Upper Jurassic ("Morrison") with primitive crocodilians and large sauropods; and finally a thick sequence in the Cretaceous of New Mexico are demonstrably in sequence and provide evidence for a discussion of climatic paleogeographic and faunal changes, as well as biotic relalationships with other parts of the world.

EARLY PALEOZOIC STRATIGRAPHY OF SOUTHERN CHEROKEE COUNTY, ALABAMA*

BY PRESTON E. CLOUD, JR., AND KARL M. WAAGÉ

The Weisner formation marks the base of the section. Evidence from Weisner Mountain suggests equivalence of sandstones there with rocks elsewhere referred to the Weisner.

The Shady formation is represented by cherty ferruginous druses overlying the Weisner sandstones on Weisner Mountain. These were formerly mapped as Rome.

Lenses of "typical Rome" lithology occur in argillaceous beds carrying a Rutledge fauna.

The term Conasauga formerly included shales of Normanskill age as well as argillaceous and carbonate rocks of Middle and Upper Cambrian age.

The Knox group of carbonate rocks, about 2000 feet thick, is divisible into five units. The basal member of the Copper Ridge formation is a zone of chertified digitate stromatolites. Above this is a characteristic faunal zone followed by nondescript cherts. The Chepultepec formation is characterized by cherts with an easily recognizable fauna. Thin sandstones occur sporadically near its base and middle. Above are the Longview or *Lecanospira* beds and the Newala or *Ceratopea* beds having sandstone and brittle liesegang cherts as characteristic elements.

* Presented with the permission of the Director, U. S. Department of Interior, Geological Survey.

Graptolitic shales of Normanskill age occur on the south side of Frog Mountain in faulted relationship to the surrounding rocks.

The Frog Mountain sandstone, perhaps 500 feet thick, contains Middle Devonian, probably Onondaga, fossils. Some isolated patches of this sandstone are grabens.

Rocks of Mississippian age occur, but their relationships are obscure.

The bauxite in Appalachian Alabama is typically associated with residual materials derived from rocks of the Knox group. Bauxite is not restricted to any particular zone in the Knox.

NORTH AMERICAN CHITINOZOA*

BY CHALMER L. COOPER

A number of species of Chitinozoa have been discovered in the insoluble residues of middle Paleozoic formations from the Mississippi Valley. These coelenterates consist of small rod-, club-, or flask-shaped brown or black forms. They are translucent to opaque, structureless, and very small, the largest varying from 0.07 to 1.5 mm.

First described in Europe, where they are found in the Silurian of Bohemia and the Baltic, these fossils are associated with arenaceous Foraminifera, Hydrozoa, cysts, and other forms of doubtful affinity. They are common in the insoluble residues of Silurian limestones and dolomites. Other occurrences extend the known range of the class from the Middle Ordovician into the upper part of the Middle Devonian.

The forms closely resemble certain Recent chitinous Foraminifera, and there is considerable evidence for the consideration of their affinity with the Hydrozoa. Probably much more work on additional materials will be necessary before the systematic position of these fossils can be established with certainty.

OSTRACODES FROM THE CERRO GORDO FORMATION (UPPER DEVONIAN) OF IOWA

BY CHALMER L. COOPER

Recent check lists showing the distribution of Paleozoic ostracodes demonstrate the nearly complete absence of Upper Devonian ostracodes described from North America. A study of the microfauna of the "Hackberry" beds of Iowa reveals a number of new species. Most of the characteristic species found in the very prolific Middle Devonian Hamilton formations of Ohio, Michigan, and Ontario are absent in this fauna, and some species seem to have a decided Carboniferous aspect.

ORDOVICIAN MICROCRINOID

BY CAREY CRONEIS

The morphology of a new microscopic crinoid from the Ordovician Bromide formation at Rock Crossing, Oklahoma, is described. The almost perfectly preserved type specimen, which in several respects is quite the most remarkable fossil crinoid ever discovered, was collected by Professor W. H. Shideler of Miami University, Oxford, Ohio. The specimen, whose maximum dimension, including the length of two stem ossicles, is approximately .4 mm., closely resembles in shape, size, and plate arrangement the early nonbrachiate pentacrinoid stage of such modern crinoids as *Compsometra, Isometra,* and relatives. The possible significance of these resemblances is discussed.

---

* Published with permission of the Chief, Illinois Geological Survey.

SOME DENDROID AND HYDROZOAN-LIKE FORMS FROM THE LOWER ORDOVICIAN OF OKLAHOMA

BY CHARLES E. DECKER

Associated with graptolites which have been collected from time to time in the old crusher quarry at Big Canyon, Oklahoma, are some Hydrozoan-like forms. They occur in the West Spring Creek formation of the Arbuckle group. The forms will be illustrated and described and their relationships discussed.

CORALS FROM THE CHOUTEAU LIMESTONE (KINDERHOOK) OF THE MISSISSIPPI VALLEY*

BY WM. H. EASTON

The Choteau limestone is the oldest Carboniferous formation in the Mississippi Valley in which there is an extensive coral fauna; therefore, the corals are restudied to ascertain their relationships with other faunas, as well as their taxonomic position in the light of modern usage. The genera *Clinophyllum* and *Neozaphrentis* were founded on Chouteau species, but the types of the genotypes have not previously been studied by sections. Other Chouteau types are restudied and their morphology determined. More than one species of *Cleistopora* (formerly called *Leptopora*) is present, and the range of the genus is discussed; *Vaughania,* which has been suggested as a junior synonym of *Cleistopora,* is found to be a distinct genus.

CORALS FROM THE UPPER MISSISSIPPIAN OF ALABAMA AND TENNESSEE

BY WM. H. EASTON

Two new species of *Caninia* are described. The first true *Palaeosmilia* from North America is described, and the relationships of the genus are briefly reviewed. The coral sequence of part of the Appalachian Carboniferous is outlined.

UPPER DEVONIAN BRYOZOA FROM NEW MEXICO

BY MADELEINE A. FRITZ

A recently discovered bryozoan fauna from New Mexico is discussed; general areas from which the fossils were obtained include the San Andres Mountains, Sacramento Mountains, and the Mimbres Range.

Ten new species and 3 unnamed species are described and illustrated. The strata from which these fossils were collected have been regarded as Upper Devonian on physical grounds as well as on the evidence supplied by various groups of fossils. At first it was thought that the Bryozoa furnished contradictory evidence as to age relationships in view of their distinct Middle Devonian aspect. A consideration, however, of the evolutionary trends displayed by the species has provided a possible explanation for this apparent disparity in age.

For a relatively short period following the Middle Devonian, development of these forms seems to have been arrested and for a time to have remained static. As a result many Middle and Upper Devonian Bryozoa show a marked similarity. Certain groups reached racial old age, others had not yet approached their optimum development, while still other simpler forms do not appear to have been greatly affected by change in environment over long periods.

---

* Published by permission of the Chief, Illinois State Geological Survey.

CORALS FROM THE REDWALL LIMESTONE (MISSISSIPPIAN) OF ARIZONA

BY RAYMOND C. GUTSCHICK AND WM. H. EASTON

The Redwall limestone is best known for the prominent cliffs it forms in the Grand Canyon of northern Arizona. In a more accessible area, that of the Jerome, Sycamore Canyon, Black Mesa regions, the details of the stratigraphy of the formation were studied. Several of the limestone units yielded an excellent fauna in which the corals formed an important part. Preliminary investigations show that the following genera are present: *Caninophyllum, Homalophyllum, Syringopora,* and *Triplophyllum.*

AGE OF THE SPONGE BEDS AT LITTLE METIS, QUEBEC

BY B. F. HOWELL

The sponge beds at Little Metis have been called Cambrian by some authors and Ordovician by others. A careful evaluation of the fauna in them discloses that, although some of the genera of sponges present range down as far as the Middle Cambrian, others range up into the Middle and Upper Ordovician. The single species of brachiopod in the fauna—an *Acrotreta*—is closely related to *Acrotreta belti* of the Lower Tremadoc of Wales and the Bronsil shale of England, to *A. sabrinae* of the Shineton shale of Shropshire, the Bronsil shale, and the Stockingford shale of Warwickshire, to *A. bisecta* of the Tremadocian Navy Island formation of New Brunswick, and to the similar brachiopods found in the Schagticoke shale of New York. Thus, the sponges indicate an age somewhere between Medial Cambrian and Late Ordovician, and the brachiopod strongly suggests an early Canadian (Tremadocian) age for the beds. The field evidence also points to a Canadian, possibly an early Canadian, age.

The author expresses to Dr. Arthur Keith his gratitude for information concerning the geology of the Little Metis region.

FAUNAS OF UPPER CAMBRIAN OF NEW JERSEY

BY B. F. HOWELL

Dresbachian and Trempealeauian fossils in the Kittatinny beds of northern New Jersey probably represent four faunas: one early and one late Dresbachian, and one medial and one late Trempealeauian. Two brachiopods, a pteropod, and 3 trilobites have been found in the Dresbachian beds, and a graptolite, 7 brachiopods, and 26 trilobites have been secured from the Trempealeauian horizons. The genera, *Dendrograptus, Lingulella, Lingulepis, Westonia, Dicellomus, Linnarssonella, Finkelnburgia, Orusia, Hyolithes, Plethopeltis, Plethometopus, Stenopilus, Acheilops, Bowmania, Maryvillia, Clevelandella, Lonchocephalus, Triarthropsis, Saukiella, Calvinella, Tellerina,* and *Illaenurus,* and four new genera of trilobites are represented in the four faunas. Most of the species are new.

MIDDLE ORDOVICIAN CORRELATIONS FROM LEE COUNTY, VIRGINIA, TO CENTRAL KENTUCKY

BY GEORGE G. HUFFMAN

Limestones previously mapped as "Lowville" in Lee County, Virginia, between the cherty "Lenoir" and "Trenton" have lithologic and faunal zones that correlate with units to the east in Virginia and north in Kentucky.

The lower 250 feet of "Lowville" is stratigraphically similar to the "Ottosee" of Rye Cove, Virginia. The succeeding 550 feet have a thin *Stromatocerium* zone 65

feet above the base, one of *Hesperorthis* 10 feet higher; the base of a 100-foot zone with *Cryptophragmus* and *Cameracladia* is 55 feet above. The *Cryptophragmus* zone is lower *"Moccasin"* at Rye Cove and upper Camp Nelson in Kentucky. The upper 150 feet (Eggleston mudrock facies) is the equivalent of the Tyrone of Kentucky; the two thick metabentonites in the Eggleston are in the upper Tyrone.

The Eggleston is overlain conformably by 30 feet of crystalline limestones carrying a Curdsville fauna. The succeeding beds, 60-70 feet of alternating shale and limestone grading upward into yellow-brown calcareous shales, carry the fauna of the Lagana ("Hermitage") of Kentucky. The overlying "Catheys-Cannon" seems to correspond to middle and upper Trenton of Kentucky.

Lower Trenton age of the Tyrone is indicated by its conformability with the overlying Curdsville, homotaxial with the Hull. Correlation of the Oregon is unknown. The *Cryptophragmus* beds correspond to the Benner of Pennsylvania, classed as lowest Black River (Pamelia).

MIDDLE ORDOVICIAN LIMESTONES IN WESTERN ANTICLINES IN WEST VIRGINIA AND CENTRAL VIRGINIA

BY G. MARSHALL KAY

Middle Ordovician limestones in western anticlines in the Virginias have been compared to those in Pennsylvania. "Mosheim" and "Murfreesboro" resemble the Clover member and underlying Loysburg. "Lenoir" has the stratigraphic position of Hatter, upper beds being similar; thickness of 150-200 feet in Pendleton, Highland, and Bath counties is twice that in southern Pennsylvania, the manner of increase undetermined; "Lenoir" becomes 700 feet and *Nidulites*-bearing in Rich Patch, Alleghany County. The lowest Black River (Pamelia) Benner formation, the *Cryptophragmus* zone, is about 100 feet in Highland County, resembling the lower, Snyder, member; 20-40 feet persists in Rich Patch, and near Gap Mills, Monroe County, forming the lowest "Moccasin"; it is missing at Jennings Gap, Augusta County. Younger Black River (Lowville and Chaumont) being absent, the group disappears southeastward as in Pennsylvania. The lower Trenton, Nealmont, 200 feet of fossiliferous, shaly limestone in Pendleton County, becomes 275 feet in Highland County, sublithographic to calcarenitic limestone and calcite-flecked yellowish lime-mudstone predominant in the upper half; it becomes red shale-bearing Moccasin and overlying Eggleston southwestward. Separation of equivalents of Nealmont and "Lenoir" in the "Chambersburg" farther southeast has not been undertaken. Lowest Salona, equivalent to upper Chambersburg Greencastle, is 20-30 feet in Pendleton to Bath counties and at Jennings Gap. Succeeding argillaceous limestone in Pendleton County is like Salona, containing the typical metabentonites; the limestones coarsen southward and extend eastward to western Augusta County; belts southeastward have equivalent dark shale.

HALYSITES GRACILIS, (HALL) FROM THE ORDOVICIAN OF MANITOBA

BY E. LEITH

Unusually large coralla of *Halysites gracilis*, (Hall) with diameters up to 22 inches and heights of over 11 inches occur in the Selkirk member of the Red River formation (Ordovician) of Manitoba. The most remarkable feature of some of the Manitoba specimens is the arrangement of the corallites in single, double, or triple series within a single corallum. In certain parts of the corallum the corallites are crowded together to form a compact mass, and such parts resemble a *Favosites*. The outline

of the corallites varies from quadrangular to hexagonal. The wide, irregular reticulations are just as characteristic of these specimens as they are of the normal type of *H. gracilis*.

MID-TRIASSIC CRINOID *DADOCRINUS*

BY HEINZ A. LOWENSTAM

This study is concerned with the taxonomy and stratigraphic range of the Dadocrinidae. It is based on material collected in the type areas of Upper Silesia and the southern Alps, in Europe, where the Dadocrinidae occur in early Mid-Triassic deposits.

Reviewing the literature on *Dadocrinus*, it is surprising to note the confusion in regard to the taxonomic status of the species erected. *Dadocrinus* has aroused considerable interest as a possible link between the late Paleozoic and modern crinoids, since it is the least specialized type among the earliest Mesozoic crinoids.

Dadocrinus kunischi and *Dadocrinus gracilis* are considered valid species, on morphologic and stratigraphic grounds. *Dadocrinus grundeyi* is shown to be synonymous with *Dadocrinus gracilis*.

The variability found on alpine forms of *Dadocrinus gracilis* indicates that *Recoarocrinus recubariensis*, previously considered as a pre-Jurassic forerunner of the Apiocrinidae, is a variation boundary case of *Dadocrinus gracilis*.

MORPHOLOGICAL RESPONSE OF *ANCYROCRINUS* TO ENVIRONMENTAL CHANGES

BY HEINZ A. LOWENSTAM

In this second study on the Mid-Devonian crinoid *Ancyrocrinus*, the interpretation previously offered as to the factors controlling the development of this secondary root form are critically re-examined. New data on the root development, and the study of sediment samples in which the roots are imbedded, have clarified some of the remaining ecological problems. The extent of the influence exercised by the change in environment is discussed, based on Goldring's recent description of the previously unknown crown and the entire stem of *Ancyrocrinus bulbosus*.

Lack of specialization of crown and stem confirms the interpretation, based on the root study alone, that the response to rough-water action was confined to modifications of the primary root relict. These modifications are the expression of an attempt to regain stable anchorage within the limits of postlarval means. Ehrenberg's view, considering *Ancyrocrinus* as a step toward eleutherozoic life which failed, is rejected, and his supposed evidence of further changes of the mode of life seen in the cast-off roots is explained to be the result of a slow rate of sedimentation permitting disarticulation of the crinoid skeletons.

MARINE INVERTEBRATE FOSSILS FROM THE RARITAN FORMATION OF NEW JERSEY

BY HORACE G. RICHARDS

This study is part of a co-operative program arranged between the Academy of Natural Sciences of Philadelphia and the New Jersey Department of Conservation and Development (Geological Survey and State Museum). Thirty species or varieties of mollusks are recorded from the Raritan formation of New Jersey; of these, 14 are new, and 7 additional are reported from the Raritan formation for the first time. The closest relationship of the Raritan fauna is with material dredged from

Banquereau, Nova Scotia, and with the fauna from the Woodbine formation of northeastern Texas. Both are regarded as basal Upper Cretaceous. Most of the fossils studied came from the vicinity of Sayreville, New Jersey.

AGE OF THE TRENTON CRINOID BEDS AT KIRKFIELD, ONTARIO

BY G. WINSTON SINCLAIR

In subdividing the Trenton formation Raymond correlated beds at Hull, Quebec, and Kirkfield because of the local abundance of echinoderms in each. The name Hull was given to the formation. Since then this correlation has been accepted as axiomatic. However, the Kirkfield beds have no resemblance to the Hull lithologically, and an examination of the fauna indicates an essential contemporaneity with the Rockland formation rather than with the crinoid beds at Hull. Beds of Hull age have been reported in New York, but this correlation is based on resemblance to the Kirkfield beds and is considered to be erroneous.

ORDOVICIAN EDRIOASTERIDS

BY G. WINSTON SINCLAIR

Pre-Cincinnatian edrioasterids were sessile on the sea floor or accidentally on other benthos. Cincinnatian and later forms selected a particular organism for attachment and thus assumed a regularity of position which the earlier species lacked. It is suggested that the possession of an inherent direction of curvature of the ambulacra dates from the introduction of this selective factor. While ambulacral direction is a criterion of generic rank for the Cincinnatian forms it is not considered valid for discrimination of the earlier ones. It is suggested that the genera *Foerstediscus* and *Isorophella,* based on this factor, are unnecessary.

FORAMINIFERA FROM THE DUCK CREEK FORMATION OF OKLAHOMA AND TEXAS

BY HELEN TAPPAN

One hundred and twenty species of Foraminifera (37 new) are described from the Duck Creek formation of southern Oklahoma and northern Texas. Twenty-eight of the previously described species are recorded from this formation for the first time. There are 59 genera and 18 families represented, the family Lagenidae comprising over one third of the total number of species, and the Textulariidae and Buliminidae next in number of species. Five generic ranges are extended downward into the Lower Cretaceous: *Ammobaculoides* and *Hastigerinella,* which had not previously been recorded below the Upper Cretaceous, and *Siphotextularia, Unicosiphonia,* and *Stichocibicides,* not previously known below the Tertiary. One new genus is described.

An unusually large number of twinned specimens and freaks have been found, of both the calcareous and agglutinated types. Such an occurrence in modern faunas suggests a warm, shallow-water environment. It is hoped that more complete evidence as to the environment at the time of the deposition of the formation will be obtained by future study.

PACIFIC COAST BRANCH MEETING AT CALIFORNIA INSTITUTE OF TECHNOLOGY IN APRIL

RADIOLARIAN FAUNA FROM THE UPPER CRETACEOUS OF THE TESLA QUADRANGLE MIDDLE CALIFORNIA

BY ARTHUR S. CAMPBELL AND BRUCE L. CLARK

This paper describes a radiolarian fauna (approximately 100 species) which was obtained from about 1 cubic inch of limestone, given to the writers by Dr. Arthur Huey. The sample came from near the top of a series of shales mapped by Anderson and Pack as Moreno, but these shales are somewhat older than those of the type section of the Moreno.

Nine families are represented by 25 genera in this fauna. It may be referred to as a *Saturnalis* fauna, so called because of the prominence of that genus and of related genera. These are ring-bearing forms which are rare in Tertiary strata. No Tertiary or recent species of Radiolaria have been recognized in this fauna.

The presence of a number of very large and generally coarse species of radiolarians; the number of many-jointed and basally fenestrated Nassellaria; the lack of delicate apophysate types; and most fortunately the association of related fossil species with laricate ciliates (*Parafavella* = *Tintinnus* sp., Rust, 1885) similar to the recent Arctic forms which flourish at freezing temperatures indicate that this Cretaceous fauna lived in cool waters. This is in marked contrast to the tropical condition that existed during the Upper Eocene in middle California, as shown by the radiolarian fauna described recently by Clark and Campbell from beds of that age.

RECENT PACIFIC COAST CORAL FAUNAS

BY J. WYATT DURHAM

Of 25 species of corals found in the Gulf of California and 15 species which occur in the North Pacific coastal areas, not more than one species is common to the two areas. The boundary between the two faunas apparently falls at or near Cape San Lucas. On the contrary, the Gulf of California fauna is closely related to that of the Panamic area. Many species are found in both regions or are replaced by closely allied forms. The geographic distribution of the corals appears to be limited largely by temperature.

The North Pacific coastal fauna is composed of species of the following genera: *Astrangia, Balanophyllia, Caryophyllia, Coenocyathus, Ceratotrochus?, Dendrophyllia, Desmophyllum, Paracyathus.* Of these *Balanophyllia, Caryophyllia,* and *Paracyathus* are the most widespread and common. *Caryophyllia* ranging north to Prince William Sound, Alaska. Within the Gulf of California, *Caryophyllia* and *Coenocyathus* have not been recorded, *Balanophyllia* and *Paracyathus* are rare, *Astrangia* is represented by several species, and *Dendrophyllia* by a markedly different species. The other genera present in the Gulf are: *Astrangia* (*Coenangia*), *Cycloseris, Endopachys, Pocillopora, Porites, Stephanaria,* and possibly *Montipora.*

Within the Gulf of California and southward occasional coral reefs are found. All that have been noted are monospecific in composition, composed either of *Pocillopora robusta* or *Porites californica,* in contrast to the common coral reef which is composed of many genera and species. (Geological Society project.)

STATUS OF THE OLIGOCENE

BY J. W. DURHAM, J. B. CATHCART, AND J. J. GRAHAM

At the time Lyell proposed his divisions of the Tertiary, he provided expressly for the insertion of intermediate units. Beyrich (1854) proposed the term Oligocene for those beds in Germany between Lyell's Eocene and Miocene. His Oligocene included Tongrian, Rupelian, and the yellow marine sands near Cassel (Chattian of later authors). He did not, as Vaughan implied (1924), consider only these sands as type Oligocene. Lyell and Beyrich's Miocene did not include the Aquitanian which some later authors consider may be equivalent to the Chattian.

Early American determinations of Oligocene were usually based on position between strata commonly considered as Eocene and Miocene. A direct correlation between American and European Oligocene was made by Vaughan, who correlated the upper part of the Vicksburg group (Flint River) with the Antigua formation of the Leeward Islands, and these in turn were correlated with the Rupelian of Italy on the basis of the great similarity of the coral faunas.

There has been much disagreement as to what is Oligocene on the west coast of America. For example, Kleinpell (1938) included in the Oligocene his Refugian, Zemorrian, and Saucesian stages, whereas Clark (1941) included only the equivalents of the Refugian and Zemorrian stages (San Emigdio, Pleito, and Concord formations, and their equivalents).

RESTORATIONS OF EXTINCT ANTELOPES FROM WESTERN NORTH AMERICA

BY E. L. FURLONG AND CHESTER STOCK

An exhibit displays head restorations of *Antilocapra, Capromeryx, Stockoceros, Sphenophalos, Ilingoceras, Hexobelomeryx,* and *Merycodus.* A restoration is also shown of an entire animal of *Capromeryx minor* from the Rancho La Brea Pleistocene. These restorations represent the work of the sculptor, William Otto, and demonstrate strikingly the unique variations in horn cores and sheaths which characterize the Antilocapridae of the later Cenozoic.

UPPER CRETACEOUS AMMONITES OF THE GENUS *BACULITES* IN CALIFORNIA

BY ARTHUR W. NAUSS

Specimens of Senonian *Baculites* in California may be segregated into at least five distinct morphologic groups.

(1) *Baculites chicoensis* Trask 1856, from the Chico formation, Chico Creek (sec. 35, T. 23 N., R. 2 E.), Butte County, is smooth, has a rounded keel on its siphonal side, which may also have faint corrugations. The sutures are uniform.

(2) Specimens from Jordan Ranch, Arroyo del Valle, 8 miles south of Livermore, Alameda County, have well-defined crescentic ridges following the growth lines and corrugations on the siphonal side. A siphonal keel is absent. It resembles *Baculites fairbanksi* Anderson externally.

(3) Specimens from the Chico formation of the Pentz area, Butte County, are smooth and have sutures more closely resembling those of *Baculites inornatus* Meek 1857 (figured as *chicoensis* by Meek, 1876) than *Baculites chicoensis* Trask.

(4) Specimens from the "*Pachydiscus* silt" member of the Panoche formation (sec. 7, T. 19 S., R. 15 E., Fresno County) have sharp, short, widely spaced nodes. A flattened dorsal side produces a trigonal cross section. The second lateral lobe of

the suture is broad, and the small siphonal sublobe on the siphonal saddle (lobe "b" of Elias) is bifid.

(5) Specimens from sec. 12, T. 28 S., R. 18 E., Kern County, are compressed in cross section, and the suture is similar to that of *Baculites compressus* Say.

VARIATIONS OF SOME FORAMINIFERA FROM THE LOWER TERTIARY ZEMORRIAN STAGE IN SOUTHERN CALIFORNIA

BY W. THOMAS ROTHWELL, JR.

Slides are shown which exhibit some important morphologic variations of a few well-known Foraminifera from the Zemorrian stage of the Santa Barbara-Santa Maria district of southern California. Comparison is made with related species in southern San Joaquin Valley. Evidence for paleogeographic interpretation is suggested. Three new species from the same region are assigned to the genera *Eponides, Cibicides,* and *Virgulina.*

SKULL OF A PLIOCENE BADGER FROM OREGON

BY CHESTER STOCK AND E. RAYMOND HALL

Through courtesy of Mr. A. L. Brown of Burns, Oregon, a fairly complete skull of a fossil badger has been made available for study. This specimen was found by Mr. Brown on Stinking Water Creek near Drewsey, Oregon. A small assemblage of fossil mammals obtained at this locality in 1931 by C. Stock and E. L. Furlong, part of which was listed by R. W. Wilson in 1937, suggests an age comparable to that of the Thousand Creek beds, northwestern Nevada.

Fortunately, a small fragment of the lower jaw with teeth was found with the skull. This resembles closely a specimen described as *Taxidea nevadensis* by Butterworth from the Thousand Creek Pliocene. The present material demonstrates that the American Pliocene badger cannot be referred to Zdansky's genus *Parataxidea* from the Pliocene of China. For the first time it is possible to demonstrate the characters of the upper dentition of the American Pliocene type.

STRATIGRAPHIC IMPORTANCE OF THE TINTINNIDAE (CILIATA HETEROTRICHIDA)

BY HANS E. THALMANN

As far as the writer is aware no one in this country has undertaken a study of the tiny fossil Protozoa belonging to the family Tintinnidae which are so abundantly represented in fine-grained limestones of Upper Jurassic (Tithonian) and Lower Cretaceous age in Spain, Balearic Islands, Corsica, French, Swiss, and Italian Alps, Carpathians, Tunisia, Algeria, Crimea, Caucasus, and Himalaya Mountains. G. Colom Casasnovas in Mallorca has recognized the following genera: *Calpionella* Lorenz 1901 (*C. alpina* Lorenz, genotype), Tithonian to Berriasian; *Calpionellites* Colom 1938 (*Calpionella darderi* Colom 1934, genotype), Neocomian to Hauterivian; *Calpionellopsis* Colom 1938 (*Calpionella oblonga* Cadisch 1932, genotype), Neocomian to Barremian; *Favelloides* Colom 1938 (*F. balearica* Colom 1938, genotype), Neocomian to Barremian; and *Rhabdonelloides* Colom 1938 (*R. inesperata* Colom 1938, genotype), Valanginian.

Species belonging to these pelagic genera are characteristic of detritus-free, sublithographic limestones, associated frequently with Radiolaria, coccoliths, and minute "*Lagena*" *colomi* de Lapp (=*Nannoconus steinmanni* Kamptner), while foraminiferal plankton is either absent or unrecognizable due to recrystallization or

secondary alteration. When Radiolaria abound, the Tintinnidae become sparse.

Fossil Tintinnidae of the new subfamily Calpionellidae herewith proposed for the above-mentioned genera may play the same important stratigraphic role in Upper Jurassic to Lower Cretaceous times as does the foraminiferal genus *Globotruncana* in Upper Cretaceous time. It would, therefore, be of great interest and importance to discover these microfossils in the Americas in rocks of Tithonian to Barremian age and to compare them with the Recent species figured by Kofoid and Campbell (1929).

GLOBOTRUNCANA IN THE FRANCISCAN LIMESTONE, SANTA CLARA COUNTY, CALIFORNIA

BY HANS E. THALMANN

Thin sections of a limestone collected at the Permanente Quarry in Santa Clara County, California (Palo Alto quadrangle, secs. 17 and 18, T. 7 S., R. 2 W.), which is mapped with the Franciscan rocks in the Santa Cruz folio, contain specimens of single-keeled *Globotruncana sp. aff. G. appenninica* Renz and double-keeled *Globotruncana linnciana* (d'Orbigny), besides unidentifiable Globigerinae ? Lagenae (of the *L. collomi* de Lapparent type) and remains of an arenaceous form (? *Haplophragmoides*). This limestone probably represents the correlative of the Calera limestone member of the Franciscan, as mapped in the San Francisco Bay folio (Lawson, 1914).

The presence of the genus *Globotruncana* in the limestone of the Permanente Quarry unquestionably places this member of the Franciscan in the Upper Cretaceous. The occurrence of *Globotruncana sp. aff. G. appenninica* Renz associated with *G. linneiana* (d'Orbigny) leads to the conclusion that the limestone is not older than Turonian and not younger than Santonian (Lower Senonian). This age determination, based entirely on smaller Foraminifera, removes this part of the Franciscan from the Jurassic.

Foraminiferal assemblages similar to if not identical with the one observed in thin sections of the limestone at the Permanente Quarry are known to the writer from Turonian and Lower Senonian rocks in the Swiss Alps, the Isonzo region and Julian Alps, the Balearic Islands (Mallorca), the Pyrenees, and other localities within the area covered by the ancient Tethys sea in Upper Cretaceous time.

OCCURRENCE OF THE GENUS *LACAZINA* MUNIER-CHALMAS IN THE EAST INDIES

BY HANS E. THALMANN

In 1935 J. H. F. Umbgrove questioned the Eocene age of the *Lacazina*-bearing rocks in the East Indies, because in Europe the representatives of this miliolid genus are restricted to the Upper Cretaceous (Bouches-d-Rhone in France, Trago di Noguera in Spain). The fact, however, that at many places in the East Indies (~~especially~~ New Guinea) *Lacazina* limestones are stratigraphically above beds often extremely rich in *Camerina* and *Discocyclina* is clear evidence for the Eocene age of these rocks. No other Eocene occurrences of *Lacazina* rocks are known outside the eastern half of the East Indian Archipelago; they seem to be restricted to Celebes, Dutch New Guinea, Mandated Territory of New Guinea, and Great Kei Island.

Lacazina rocks have been reported from: Bocalemo peninsula in East Celebes; Pisang Island, east of Misool; Onin Island; Dramai Island; south and east of Triton Bay; Setawka River in southwestern New Guinea; northwestern coast of New Guinea (Vogelkop area between Rumberpon and Horna, and at Soengei

Ingsiim); on Wilhelmina-Top in the Lorentz River basin of southwestern Dutch New Guinea; at several localities along the trail leading from the southern coast to Lake Wissel in New Guinea (near Orawja, on ridges southwest of Wissel River, and east of Lake Wissel); between Riamroe and Jamtimoer on Great Kei Island; and at Chimbu aerodrome east of the Mount Hagen in Mandated Territory of New Guinea. In all these places *Lacazina wichmanni* Schlumb., associated with *Camerina, Discocyclina, Alveolina,* and sometimes with *Biplanispira* and *Pellatispira,* occurs abundantly. In a rock specimen collected in the region of the Wissel Lake by Arn. Heim, the writer counted more than 25 individuals of this species per square centimeter. In many instances the same sample displays two forms of *L. wichmanni:* one with up to 20 narrow concentric rings and well-developed trabeculae, and one with 8-10 flosculinized rings and typical tremaẗophores.

MIDDLE MIOCENE VERTEBRATE FAUNA FROM BEATTY BUTTES, OREGON

BY ROBERT E. WALLACE *

A vertebrate fauna from Beatty Buttes, Harney County, Oregon, represents a stage essentially contemporaneous with that of the Skull Springs and Sucker Creek local faunas and is also comparable to the Mascall and Virgin Valley faunas. Eighteen species including 14 genera are represented. *Merychippus isonesus* Cope is the most common species. *Mylagaulus, Liodontia, Amphicyon, Hypohippus, Archaeohippus, Dromomeryx,* and *Merycodus* are also present.

The fossil material occurs in acidic tuffs on the north flank of the volcanic cone known as Beatty Buttes and at another locality designated as Corral Buttes approximately 20 miles northwest of Beatty Buttes.

AGE OF THE ROCKY MOUNTAIN QUARTZITE IN SOUTHERN ALBERTA

BY HARRY E. WHEELER

Since its original definition by Dowling (1907) the Rocky Mountain quartzite of southern Alberta has been assigned to the Carboniferous system (Pennsylvanian) by Shimer (1913), Allan (1914), Adams and Dick (1915), Lambe (1917), Kindle (1924), and others. On the basis of a study of the invertebrate faunas, Shimer (1926) assigned the formation to the Permian, but Warren (1927), Raymond (1930), C. C. Branson (1939), and Sloss (1942) again assigned the quartzite to the Pennsylvanian.

Lambe (1917) questionably assigned a collection of selachian teeth from the Rocky Mountain formation to *Lissoprion ferrieri* Hay of the Phosphoria formation of southeastern Idaho and western Wyoming. Through the courtesy of the Canadian National Museum the writer has re-examined these teeth and definitely regards them as belonging to the genus *Helicoprion* and to a species closely similar to *H. ferrieri* (Hay).

In its world distribution the genus *Helicoprion* is known only from strata of Permian age. The Alberta teeth were collected from the "Phosphatic horizon" of the Rocky Mountain quartzite, and they show a close similarity to the Phosphoria species. For these reasons, and because the Phosphoria formation as well as the other *Helicoprion*-bearing rocks in North America (California and Nevada) may be correlated directly or indirectly with the Word formation of Texas, the Rocky Mountain quartzite is assigned by the writer to the Guadalupian series of the Permian system.

* Introduced by Chester Stock.

ABSTRACTS OF THE SOCIETY OF VERTEBRATE PALEONTOLOGY

DECEMBER MEETING AT OTTAWA (CANCELED)

DINOSAUR FROM THE CRETACEOUS OF MISSOURI

BY E. B. BRANSON

In Bollinger County, Missouri, near the village of Lutesville, dinosaur caudal vertebrae were found in the spring of 1942. Only eight vertebrae were recovered, and they were in the clays of a filled sink in Lower Ordovician rocks. According to the owner of the land, who found the bones, the first one was encountered at a depth of 4 feet, and the last at a depth of 17 feet.

Geologists of the State of Missouri Geological Survey and Water Resources had identified patches of nonmarine sediments in the region as Cretaceous. Marine Cretaceous crops out about 20 miles southeast of Lutesville.

The author is unable to determine to which family of dinosaurs the vertebrae belong.

DEVONIAN FISHES FROM MISSOURI

BY E. B. BRANSON AND M. G. MEHL

The Devonian formations from which fishes have been collected in Missouri are Mineola limestone, Callaway limestone, Snyder Creek formation, Grassy Creek shale, Louisiana limestone, Fortune limestone, Noel shale, Sylamore sandstone, Grand Tower limestone, and Glen Park limestone.

Ptyctodus calceolus has been found in all the formations, dinichthyids and sharks' teeth in most of them.

Conodonts are represented by about 150 species but they are not included in the study.

Helodus, 4 species	Coccosteus, 1 species
Psephodus, 1 species	Dinichthys, 5 species
Eoorodus, 1 species	Mylostoma, 1 species
Paleonyhus, 1 species	Dipterus, 2 species
Holonema, 1 species	Conchodus, 1 species
Ptyctodus, 3 species	Glyptaspis, 1 species

Restorations of *Dinichthys* are discussed.

ELASMOBRANCH PECTORAL FIN MUSCLES AND NERVES

BY THEODORE H. EATON, JR., AND CARL J. NICOSIA

Squalus, Raja, and Chimaera are compared as to number and distribution of brachial nerves, form of brachial plexus, and relationship of pectoral fin muscles to body segmentation. Study of these and ancient sharks suggests that a broad-based pectoral with dorsal and ventral (levator and depressor) groups of muscles is a more probable ancestral form in Elasmobranchii than the alternative, proposed by Howell (1933), of a crutch-prop fin with protractor and retractor muscles.

NEW GENUS OF AMERICAN PLIOCENE BADGER, WITH REMARKS ON THE RELATIONSHIPS OF BADGERS OF THE NORTHERN HEMISPHERE

BY E. RAYMOND HALL

A nearly complete skull of a badger from Middle Pliocene beds on Stinkingwater Creek, Oregon, proves to be *Taxidea nevadensis* Butterworth of the Thousand Creek Pliocene of Nevada, a species representing an unnamed genus on or near the line

of descent of the Recent American badger, *Taxidea*. Zdansky (1924) regarded *Taxidea nevadensis* as *Parataxidea* of the Hipparion fauna of the Tertiary of China, correctly indicated descent of *Parataxidea* from *Trochictis* of earlier beds in Europe, reasoned that the migration of *Parataxidea* to America from Asia required a long time, and therefore suggested that the Hipparion fauna of China might be Upper Miocene since the American deposits yielding *Taxidea nevadensis* were Pliocene. This suggestion must be discarded because *Parataxidea* probably does not occur in North America and the line of descent of *Parataxidea—Meles* (Recent badger) of the Old World, and the line of descent of *Taxidea* in the New World are distinct as far back as the Lower or Middle Pliocene.

Special structural features are the large tympanic bullae and posterior teeth adapted to a mixed diet of insects and small vertebrates. This diet may have geographically limited the badgers to nonboreal areas south of the land bridge across Bering Strait. Two other large mustelids, wolverine and ratel, were generically, and perhaps specifically, indistinguishable in the two continents in the Pliocene, but each was adapted to a diet of flesh of larger animals, obtainable the year round in boreal regions. The ratel was the less aggressive and retired to southern latitudes leaving the wolverine in possession of the boreal regions. The ratel died out in America, and the wolverine is conspecific even today in the two continents.

If competition had taken place between badgers of the Old and New Worlds in the Pliocene or later, *Meles* of the Old World might now inhabit most of North America as well as Asia, as does the wolverine, *Gulo*, and *Taxidea* of the New World might today be confined to southern latitudes in America as *Mellivora*, the ratel, is in Asia and Africa.

CITELLUS PARRYI FROM THE PLEISTOCENE OF ALASKA

BY JOHN ERIC HILL

A large series of ground squirrel skulls and skeletons in the Childs Frick collection in The American Museum of Natural History agree closely with Recent *Citellus parryi ablusus* from the same region. They were associated with mammoth giant bison and horse remains. Studies by Dr. A. C. Whitford showed that hairs of mummified specimens of these ground squirrels, also in the Frick collection, agreed better with hairs of *C. p. ablusus* than do hairs of other Recent races of the same species.

Cranially the Pleistocene ground squirrels show slightly wider zygomatic spread and relatively greater mastoid breadth. The latter measurement is the only one statistically significant.

ENDOCRANIAL ANATOMY OF SOME OLIGOCENE ARTIODACTYLA

BY FRANK C. WHITMORE, JR.

By the serial sectioning method, studies were made of the endocranial anatomy of the genera *Merycoidodon, Leptomeryx,* and *Poebrotherium;* the observations made were checked by dissection of these and closely related forms.

In these genera, in contrast to living artiodactyls, the internal carotid artery was well developed but possessed no *rete mirabile*.

Venous blood returned from the face via the subsphenoid canals in the body of the basisphenoid bone and also by way of the sinus canal through the braincase itself. This is a primitive cranial circulation pattern, found in living mammals only among the Marsupialia, Insectivora, Lagomorpha, and a few Rodentia. The condition in

living Artiodactyla is in sharp contrast to this pattern in that the posterior passage of venous blood from the face takes an entirely extracranial route. It is concluded that, in the course of artiodactyl evolution, the external jugular vein has supplanted the internal jugular as the dominant efferent cranial vessel.

In *Poebrotherium,* the *pars petrosa* of the periotic bone contains a deep fossa in its dorsal (endocranial) surface, which is enclosed dorsally by the arch of the posterior semicircular canal. This is also present in living Tylopoda (it has never before been recorded) and houses the *lobulus petrosus* of the cerebellum. It occurs in no other Artiodactyla, a fact which emphasizes the long independent existence of the Tylopoda.

ABSTRACTS OF SECTION E, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

DECEMBER MEETING AT NEW YORK (CANCELED)

FUNCTION OF ECONOMIC GEOLOGISTS DURING AND AFTER THE WAR

BY CHAS. H. BEHRE, JR.

Judged by the actual situation at present, and omitting the many uses, not generally well known to the profession, to which geologists have been put for strictly military purposes, there are now numerous outlets for economic geologists in services connected with the war. In what follows, reference is made only to strictly economic work, since other phases of geologic application have been discussed elsewhere. Geologists have been extensively used by the State and Federal geological surveys, by various government mineral production and control agencies specifically created for the war (Board of Economic Warfare, War Production Board, etc.), and by various branches requiring advice dealing with mineral production or resources (intelligence branches of various military services, State Department, etc.). Conspicuous facts include: the fact that very able men have been usable, regardless of their field of specialization; the difficulty of obtaining enough men in the middle years suited and needed for such work; the abundance of young men of draft age available; and the desirability of stressing training in mineral economics as supplemental to training in pure geology and mineral exploration and technology. A reciprocal admissions policy with Canada is advocated for the profession. In post-war times, need will certainly be felt for economic geologists trained in exploration and development in the broader sense, especially in Africa and South America. The role of women in such occupations will be real but limited.

NEW WORKING HYPOTHESIS FOR THE FORMATION, STRUCTURE, AND MOTIONS OF THE EARTH

BY FREDERIKA BLANKNER

All things capable of study in the laboratory to date have been found to be vibratory however nonvibratory in appearance, thus confirming the original intuition of Heraclitus that "all things flow". Hence it is deduced that interstellar space and/or the contents thereof (ether or otherwise) is vibratory also. Evidence that ether is vibratory appears in cosmic rays, light waves, radio waves; that mind is vibratory, in brain waves. Especially if space curves or is solid, it should be capable of vibration.

The present hypothesis holds that the formation, basic structure, and motions of the earth, as of other heavenly bodies, systems, and galaxies, result from the action of vibration in interstellar space; that is, that they are vibration designs or cosmic "Chladni figures", the matter thereof having gathered in the cosmic nodes or quiescent sections, since in any vibrating region matter cannot collect in the antinodes or places of activity. Thus vibration, demonstrably the cause of the earth's superficial structure (acting there through water, air, heat, etc.) is held to be the cause also of its structure as a whole.

The presence of waves and currents in interstellar space and/or the contents thereof, like those in earth, fire, ocean, and atmosphere, would explain why all cosmic matter does not collect in one mass through the power of gravitation. It would explain also the rotation and revolution of the earth and of other planets

and planetoids, each in one of the nodal "grooves" of a spheroidal vibration having solar activity at its center; the recurrence of glacial ages—that is, fluctuation in the earth's temperature with or without possible variation in the tilt of the earth's axis and/or possible pulsation of the earth's orbit (*compare* fluctuating light vibrations of pulsating stars); the collection on the earth of meteors and meteorites, in these as in all falling objects vibrational push combining with gravitational pull; the probable maximum density at the center of the earth and the deficient density of matter lying above the geoid.

EXTRUSIVE AND RELATED ROCKS OF NORTHEASTERN NEW MEXICO

BY ROBERT F. COLLINS AND HELEN STOBBE

Eastern Colfax County and northern Union County in northeasternmost New Mexico contain approximately 700 square miles of basalt flows. The large sheets appear to have been fissure eruptions although extrusion loci are not correlated with post-Eocene regional structure. Physiography indicates at least three periods of extrusion, separated by active stream erosion. Scoria cones are present on flows of all periods but are most numerous on intermediate period flows.

Petrography correlates broadly with age of extrusion. Olivine basalts predominate in all three periods, but the oldest (high-level) flows are richest in olivine and almost devoid of plagioclase phenocrysts. Intermediate basalts have less olivine and more pyroxene and plagioclase; they vary most in mineralogy and include olivine basalts, olivine-free basalts, quartz-bearing olivine basalts, and feldspathoid basalts. The recent basalts carry the least olivine and have the best-developed plagioclases.

Andesites, trachytes, soda trachytes, and phonolites are approximate contemporaries of the intermediate basalts. The oldest nonbasaltic rock is younger than the oldest basalt; most of the nonbasaltic rocks are slightly older than the intermediate flows. The andesites are relatively uniform petrographically and form steep cones in northeastern Colfax County. The trachyte flows and dikes are rarest and are closely bunched in central eastern Colfax County. The soda trachyte-phonolite rocks are the most extensive and variable of the group and are found in central eastern Colfax County as flows, sills, and dikes.

Furthermore, there are sizable areas of feldspathoid extrusives in western Union County at Emory Peak, Sierra Grande, and Don Carlos Hills.

YELLOW FEVER AND THE DEVELOPMENT OF TRANSPORTATION IN THE HUMID TROPICS

BY ZYGMUNT DEUTSCHMAN

Yellow fever control is essential in view of the potential danger of sudden epidemics both inside and outside of the endemic areas, which include the humid tropics of America and Africa. The risk is greater with increased road facilities, and this traffic is more difficult to contend with than air traffic, as has been demonstrated by a recent important epidemic.

The geographical approach to the problem of yellow fever is the study of the ecology and pattern of distribution of the yellow fever virus in various links of the "Complex" (M. Sorre, 1933) consisting of man acting both as carrier and patient, the vector *Aedes aegypti*, a domestic mosquito, and a natural reservoir of the virus such as monkeys or the naturally infected mosquito.

Important contributions to the progress of the epidemiology of the disease during the last 40 years have vastly modified the picture of the geographical distribution

of the virus. The main landmarks were the recognition of the "rural" inland type of the disease in addition to the "urban" coastal type, both *Aedes aegypti*-born forms. Finally, the introduction of two new means of diagnosis led to the discovery of a "jungle" type of disease in complete absence of the accepted vector *Aedes aegypti*.

The "urban" and "rural" types of disease are likely to involve nonimmune people of all ages and tend to spread along the routes of human travel. They are dependent for their maintenance on the close association of man and *Aedes aegypti*. The third, or jungle, type is acquired only by forest workers, does not spread to other members of the community in the absence of *Aedes aegypti*, and spreads through jungles irrespective of routes of human travel.

The jungle type which now dominates the epidemiological picture in South America can be brought under control only by individual immunization of exposed members of the population, a procedure which obviously cannot be applied to the majority of the indigenous population.

DEPOSITS ASSOCIATED WITH WASTING GLACIAL ICE IN THE VERMONT VALLEY, FROM SHAFTSBURY TO RUTLAND

BY C. E. GORDON

In western Vermont a comparatively narrow strip of relative lowland, excavated along a belt of weak rocks below the summit levels of the Green Mountain upland on the east and those of the Taconic hills on the west, is known as the Vermont Valley. It extends from Pownal to the vicinity of Rutland.

Study of the modified drift deposits indicates that at all the various stages of deglaciation which they represent the Valley ice was stagnant. Frontal recessional moraines and associated outwash plains are lacking. The meltwaters, while often ponded, behaved essentially as streams. They escaped around, over, or through the ice, probably in different directions at different times.

The boulder drift on the mountain slopes suggests that the ice melted down from the upland summits. At the lowland summit levels veneers were initiated on the Valley ridges. Marginal contact terraces or plains were built on the hillsides as the ice shrank into the intervening hollows. Many areas at different levels record sites of melting ice blocks. Some of these areas are now covered only with material let down by the ice, others are strewn with scattered kames, others are covered by shallow plains, depending upon the way the ice melted. Occasional ridges, or strings of kames, mark long rifts in the ice. Heavy forest cover conceals much in the hills along the east side of the Valley, but in the less rugged western part broad, sloping, uneven, recessional plains, or kame terrace forms are conspicuous features.

SOILS AND MEN IN WESTERN AFRICA AND MADAGASCAR

BY JEAN GOTTMANN

The soil problem is one of the most delicate and important in the development of the humid tropics. In tropical Africa some important studies have been made recently, particularly in the French colonies of western Africa and Madagascar. A rapid survey of results may lead to conclusions of general interest.

The chief problem is the rapid deterioration of the intensively exploited soils, which leads in most cases to laterization. In the humid climates of tropical Africa the soils require constant remineralization to prevent the progress of laterization, according to H. Scaetta's works of 1937-1940. If this theory is well founded the

prospects of further development will be revolutionized. In West Africa soil often determines the distribution of native population and only the belts of non-laterized or non-laterizable soils seem to have been densely populated over a long period.

On Madagascar the picture is the reverse: the greater part of the island soils have been ruined by an extensive pastoral economy, but in the western part large strips of good, non-laterized soil are found. The population is nevertheless gathered in the central and eastern regions, where the soil situation is very bad. This apparent contradiction between the distributions of good soils and of population can be explained only in terms of the economic history and colonization of Madagascar.

In fact there is no contradiction: soils determine the distribution of population only where other economic factors do not intervene and only in the case of a rationalized economy. But such an economy cannot be successful in humid tropical Africa unless integrated in a large commercial organization with broad marketing possibilities.

PSYCHOLOGICAL FACTORS IN TROPICAL ADAPTATION

BY EARL P. HANSON

In our approach to the problem of white men in the tropics, we have perhaps given too little attention to that deep rooted psychological factor that expresses itself externally in what is commonly called a way of life. The White Man's Burden psychology, which finds its greatest expression in the romantic cork-helmet school of tropical adaptation, may be a greater deterrent to success in the tropics than are temperature, humidity, and the actinic rays of the sun. Under that psychology we have developed certain rules of tropical living which are often in direct opposition to the fundamentals for healthful living that we recognize in the temperate zones; when things go wrong under those rules, we are prone to put the blame on climate rather than on our way of living; when scientists see native races getting along relatively well in the tropics, they often give credit exclusively to such things as pigmentations and immunity and tend to obscure the common-sense fundamentals of the native way of life, adjusted to the climate through centuries of occupation.

The writer has gathered much evidence in the Amazon basin; more is available from such areas as Queensland and, in the course of history, even from areas like Florida, to show that psychology is more important as a factor in warm-climate adaptation than anything that can be measured with instruments. Throughout the tropical world, men who have adapted themselves to the climate suffer far less (though often losing caste) than those who have adhered to any rigid system of rules for living there.

The problem is today of major strategic importance. In every one of the world's armies there is found that same conflict that has for years raged among explorers—between those who would adapt human beings to climate and those who would do everything possible to protect them from it. The outcome of the war may well hinge on the results of that struggle.

GLACIAL ANTICYCLONES AND PLEISTOCENE GLACIATIONS

BY WILLIAM HERBERT HOBBS

The flow of a continental glacier is restricted to an outer zone marked by surface crevassing and by bedrock erosion. Within the periglacial area geological work during the summer is accomplished by thaw water and floating ice, which build up the

outwash plain and spread boulders over its surface. At the end of summer melting stops, the plain dries up, and the winds of the glacial anticyclone take over from the thaw water the processes of transportation, erosion, and deposition. Sand hills, loess deposits, and boulder ventifacts result.

During the receding hemicycle the glacier is reduced through a reconquest of the anticyclone by the planetary winds during the summer. This is accomplished mainly by rains falling on the upper surface of the glacier and mainly on its western side. New active fronts are successively set up behind a broad front zone of dead ice. This lays down ground moraine in the intermorainal areas. Outwash deposits are made largely along water courses, but also within the interlobate areas.

"IOWAN TILL" OF IOWA, AN OUTWASH FROM THE DES MOINES LOBE OF THE LATE WISCONSIN GLACIATION

BY WILLIAM HERBERT HOBBS

The deposits are not a drift formation because:

Outline at front not that of a glacial lobe. Surface expression not that of glacial deposits: (1) no marginal moraine but deposits thin out gradually; (2) no recessional moraines; (3) material not till; (4) no roots stemming from a center of glaciation.

The "Iowan" is an outwash plain from the Des Moines lobe having these relationships:

Position: area borders and is an appendage to the lobe. *Outline:* almost identical with that of flood deposits on flattish gentle slopes. *Materials:* throughout, imperfectly stratified sands and gravels. *Pebble band:* a definite thicker pebble band over large areas shows ventifacts. *Underlying trough:* deposits occupy a shallow trough, directed south southeastward like outwash plain itself. *Surrounding rim of loess:* outside the "Iowan" plain is a thick deposit of loess which rises steeply but thins gradually outward. Marks the nearest approach of vegetation during period of flooding. *Loess veneer on the "Iowan":* later and thinner; thins gradually toward the lobe. *Boulder strewn surface:* wind-drilled and polished boulders compositionally like those in the marginal moraine of the lobe. *Giant boulders on the plain:* carried by icebergs, but from ice slabs detached from the stagnant front. *Paha at the bottleneck:* outwash sand choked the already swollen Mississippi River and crowded it eastward. When river floods subsided the channels at the bottleneck front cut gorges in their own deposits leaving drumlinoid ridges between—Paha.

LAND SETTLEMENT AND SOIL SURVEY

BY P. HONIG

In the Netherlands Indies one of the great social problems is the overpopulation of Java, which makes it necessary to find an outlet for the increase of the population by migration to the other islands of the Netherlands Indies Archipelago.

An extensive survey has been made of the available sparsely settled soils which could be used for the settlement of Javanese colonists. The selected areas would have to be adaptable to the agricultural methods customary to the Javanese for whom the use of irrigation for the cultivation of rice is a necessity. These regions would also have to cover an area of 20,000 to 30,000 hectares in order to be suitable for the establishment of colonies with villages and social organizations similar to those of their home islands.

It has been found that on the islands other than Java possibly 2 million hectares could be used for this settlement. After the first general survey of the contours

of the country, the possibility of irrigation, and the existing land rights of the neighboring indigenous population, an extensive survey of the soil as to fertility and suitability for agriculture in general was made.

For this purpose the surface soil and subsoil at levels of 30, 70, and 120 cm. were sampled and analyzed. From these samples the physical structure was determined, and it was found that phosphate, potassium and lime were the most important nutrient components of the soil. It was further determined that for the purpose of settlement the soil under good irrigation conditions must produce a harvest of at least 1000 kg. of rice per hectare per year, which is a rather low figure and for which the phosphate content has to be above 0.005 per cent and the potassium content higher than 0.01 per cent, these being considered the minimum amount of available soluble constituents in 25 per cent hydrochloric acid.

In this way it has been found that of 860.000 hectares analyzed in Sumatra, 590,000 hectares were acceptable for this migration scheme. For Borneo of 1½ million hectares only 230,000 hectares were approved, and for the other islands in the eastern part of the Archipelago (including New Guinea) of 275,000 hectares, 146,000.

The idea is that the density of the population should not exceed a maximum of 1 per hectare, which makes it possible under the present irrigation scheme to plan for the migration of about 1 million Javanese to the other islands.

Some particulars about the expectations of this migration in the future and its significance for the development of the Netherlands Indies will be given later.

PROVENANCE VERSUS MINERAL STABILITY AS A CONTROLLING FACTOR IN THE COMPOSITION OF SEDIMENTS

BY PAUL D. KRYNINE

The paucity of unstable minerals in some ancient sediments can be explained by assuming that they are reworked sediments or by the newly proposed theory of intrastratal solution which claims destruction of unstable constituents by postdepositional leaching—oldest sediments attacked longest.

A critical review of the evidence shows that: (1) Intrastratal solution exists only on a limited, local, and erratic scale. It depends upon *absolute leaching intensity* and upon *relative length of time* during which effective circulation is actively maintained. Paleozoic sediments sealed tight by early postdepositional cementation are less leached than highly permeable Pleistocene terraces. (2) Thin-section work shows that most (90%±) sediments poor in unstable minerals are reworked sediments frequently loaded with fragments of shale, slate, phyllite, sandstone, quartzite, low-rank schists, and particularly detrital chert. Sediments rich in unstable minerals generally contain igneous and high-rank metamorphic rock fragments.

These studies place composition of the average clastic sediment at approximately 25% sedimentary derivation, 45% metamorphic (about 30% low-rank), and 30% igneous and ultra-metamorphic.

Schematically lithosphere consists of an upper sedimentary layer, middle low-rank metamorphic, and lower crystalline—high-rank metamorphic and igneous layer. Moderate deformation within source area results only in erosion of upper layer, whereas only profound diastrophism uncovers deepest crystalline zone.

Differences in mineral composition probably reflect intensity of diastrophism; stable minerals (two-cycle sediments) reflect periods of quiescence, and unstable minerals indicate deep erosion following intensive deformation.

Probably provenance changes cause most mineral composition differences locally modified by intrastratal solution.

KAINGINING—AN IMPORTANT METHOD OF CROP PRODUCTION IN EQUATORIAL REGIONS

BY ROBERT L. PENDLETON

In the Temperate Zones the use of the plow and other implements is so general in the production of crops that it is difficult to comprehend the importance of radically different agronomic practices which are used in certain equatorial regions. In the Philippines, the Netherlands East Indies, Thailand, and Malaya the *kaiñgin (caiñgin)* method, often called "shifting cultivation" is important.

Selecting the site for planting, and the methods of clearing the forest, planting and weeding of the crop are described. Usually after one crop the clearing is abandoned to forest, and a new site is selected for the next year's planting. Advantages of this method are: (1) The forest is the cover crop, suppressing noxious weeds, diseases, and pests; (2) plant nutrients are concentrated near the soil surface, within reach of shallow-rooted crop plants; (3) the natural soil structure is restored; (4) crop production is possible on soils too poor to be cropped annually; (5) no draft animals are needed; and (6) soil erosion is kept at a minimum, even on steep slopes. Disadvantages are: (1) Several times as much human labor is required per unit of crop produced as in the intensive, exploitive methods of crop production; (2) from 5 to 10 times as much land is needed per family; (3) quantities of valuable timber are often destroyed; and (4) where the pressure of population on the land increases, so that the forest cannot remain on the land long enough, coarse grasses become dominant. These burn annually, maintaining savanna-like conditions, preventing the normal return of the forest. Such artificial savannas are grassy deserts for *kaiñgin* crop production, compelling the "farmers" to move on into new forested lands.

RAINY SEASON AS ADVERSE FACTOR TO DEVELOPMENT OF SOUTH AMERICAN TROPICS

BY WILLIAM E. RUDOLPH

A potent factor to be reckoned with in the South American tropics is the rainy season, with its detrimental effects upon life and human development. The very inaccessibility of interior regions of the tropics at such times is largely responsible for general lack of knowledge of the difficult conditions which then ensue. These are some of the woes of the rainy season:

(1) Regions become isolated by rising waters, small streams swelling to raging torrents which carry tons of branches and other debris, making crossings dangerous if not impossible.

(2) Failure of means of transport brings on shortage of food.

(3) Men cannot pursue out-of-doors occupations in the rain, and domestic animals are of little help at such times.

(4) Latent ailments begin to bother the peon as they suffer exposure to wet and cold, notably malaria.

(5) Streams at flood cause damage to property, as well as loss of life.

(6) The ending of the rainy season furthers the spread of malaria, for as the streams dry up they form pools in which anopheline mosquitos breed.

Construction of highways for year-round traffic is one of the strongest methods of battling these adverse influences. Having such roads, people would no longer lack proper food and the aid of their fellow man during the period when their need

is greatest. The Pan-American Highway may well give additional impetus to such road building.

AERIAL PHOTOS IN THE GEOLOGICAL CURRICULUM

BY H. T. U. SMITH

The necessities of war time have directed attention to the importance of training in the use of aerial photos. Geological departments are particularly qualified for instruction in this field, and geology students may profit especially from it. The subject involves two interrelated phases: photo interpretation and map making. These may be presented in three different ways:

(1) In conjunction with standard geology courses. An introduction to the use of photos may be given with laboratory work for the first course in geology. Various phases of interpretation may be presented in courses on structural geology, sedimentation, map interpretation, geomorphology, and economic geology. Mapping techniques may be included in field-mapping courses or in laboratory courses on cartography.

(2) By means of special courses devoted exclusively to aerial photos.

(3) By a combination of these methods. This involves a basic course on photo characteristics, methods of study, and elementary photogrammetry, followed by specific applications in courses on structural geology, geomorphology, etc.

Choice among the above approaches depends on the flexibility of individual curricula, equipment available, time allowable, and qualifications of students and instructors. Whichever plan is adopted, the following topics are fundamental: (1) elementary characteristics of photos, including scale, perspective, and distortion; (2) thorough familiarity with stereoscopic methods; (3) recognition of man-made and topographic features of all types; (4) methods of preparing and revising planimetric maps from both vertical and oblique photos; and (5) methods of measuring elevations and drawing contours.

SAND-DUNE STRATIFICATION

BY H. T. U. SMITH

Stratification is an important criterion for recognizing ancient dune deposits and for interpreting their geomorphic and climatic history. Empirically, it may be classified as high-angle and low-angle, which are properly distinguished only in exposures perpendicular to strike. These two types may be correlated with conditions of origin by deduction from the external form of active dunes and by direct observation of the bedding exposed in natural and artificial cuts through stabilized dunes. From such studies it is found that high-angle bedding is characteristic of the lee side of an advancing dune, which may be of the barchan, transverse, or upsiloidal type. Low-angle bedding, more characteristic of the windward side, is also formed on the leeward side of some dunes within certain limits as to height, and particularly in the presence of vegetation. Unless supported by collateral evidence of another nature, it is therefore of indefinite significance as an indicator of the direction of former dune-building winds. Neither type of bedding, in any one cross section, can be relied upon to indicate the original type of dune.

INDEX TO VOLUME 53 (July–December) *

Page

Additional species of the genus *Globotruncana* Cushman. By H. E. Thalmann.. *1809*
Aerial photos in the geological curriculum. By H. T. U. Smith..... *1852*
Age of Rocky Mountain quartzite in southern Alberta. By H. E. Wheeler..... *1839*
— — sponge beds at Little Metis, Quebec. By B. F. Howell..... *1830*
— — Trenton crinoid beds at Kirkfield, Ontario. By G. W. Sinclair..... *1833*
— relations of rocks of White Mountain magma series of Pliny region, New Hampshire. By R. W. Chapman..... 1533
ALBRITTON, C. C., JR., AND BRYAN, KIRK: Wind-polished rocks in Trans-Pecos region, Texas and New Mexico..... 1403
Allegheny synclinorium, Development of northern. By G. M. Kay..... 1601
ALLEN, J. E.: Igneous features of Juniper Ridge, Oregon *1815*
Analyses
  Chemical
    Intrusive rocks of Pliny region, New Hampshire. By R. W. Chapman.. 1533
    Muscovite of Dutchess County, N. Y. By R. W. Chapman..... 1299
  Fabric
    Laurel gneiss, Wissahickon formation. By R. W. Chapman..... 1299
  Modal
    Guilford granite. By R. W. Chapman 1299
    Intrusive rocks of Pliny region, New Hampshire. By R. W. Chapman.. 1533
    Laurel gneiss, schist, and quartzite of Wissahickon formation. By R. W. Chapman 1299
  Pebble. By W. C. Krumbein..... 1355
ANDERSON, A. L.: Endomorphism of Idaho batholith 1099
ANDERSON, C. A., AND MERRIAM, C. W.: Reconnaissance survey of Roberts Mountains, Nevada 1675
ANDERSON, F. M.: Record of the term "Chico Group" in geologic literature..... *1815*
Andesite breccia dikes near Blairsden, Plumas County, California. By Cordell Durrell *1818*
Another skull of *Prolacerta*. By C. L. Camp *1827*
Arctic foraminiferal faunas, Occurrence and correlation of. By F. B Phleger, Jr... 1073
Arizona, Paleozoic paleogeography of. By A. Stoyanow 1255
Arroyo Seco, Los Angeles County, California, Flood deposits of. By W. C. Krumbein 1355

Barred basin, West Texas. By R. I. Roth.. 1659
Basal Huronian conglomerates of Menominee and Calumet districts, Michigan. By F. J. Pettijohn *1806*
Basin, West Texas barred. By R. I. Roth.. 1659
Batholith, Endomorphism of Idaho. By A. L. Anderson 1099
Beach and river sands on Gulf Coast of Texas, Source of. By F. M. Bullard.... 1021
BECKWITH, R. H.: Structure of upper Laramie River Valley, Colorado-Wyoming 1491
Beechwood formation of Indiana. By Guy Campbell 1055
BEHRE, C. H., JR.: Function of economic geologists during and after the war.... *1845*
BERRY, WILLARD: Water supply in North Carolina Coastal Plain *1795*

Page

BLANKNER, FREDERIKA: New working hypothesis for the formation, structure, and motions of the earth..... *1845*
Boos, M. F.: Correlation of granites..... *1795*
BRANSON, C. C., AND BRANSON, E. B.: Sequence of Ordovician conodont faunas in Kentucky and adjacent States..... *1796*
BRANSON, E. B.: Dinosaur from the Cretaceous of Missouri..... *1841*
—, AND BRANSON, C. C.: Sequence of Ordovician conodont faunas in Kentucky and adjacent States *1796*
—, AND MEHL, M. G.: Devonian fishes from Missouri *1841*
BRYAN, KIRK, AND ALBRITTON, C. C., JR.: Wind-polished rocks in Trans-Pecos region, Texas and New Mexico..... 1403
BUCHER, W. H.: National Research Council and co-operation in geological research 1331
Bull Mountain area, upper Laramie River Valley, Colorado-Wyoming. By R. H. Beckwith 1491
BULLARD, F. M.: Source of beach and river sands on Gulf Coast of Texas..... 1021
BUWALDA, J. P.: Gouge is not positive fault evidence *1816*

California, Flood deposits of Arroyo Seco, Los Angeles County. By W. C. Krumbein 1355
Cambrian sedimentation in northern Arizona. By E. D. McKee..... *1820*
Cambro-Ordovician of the Southwest. By R. R. Wheeler..... *1812*
CAMP, C. L.: Another skull of *Prolacerta*.... *1827*
—: Sequence of vertebrate faunas in the pre-Tertiary of the Southwest..... *1827*
CAMPBELL, A. S., AND CLARK, B. L.: Eocene radiolarians from the Kreyenhagen shales of the Charleston quadrangle west side of San Joaquin Valley, California..... *1798*
— — —: Radiolarian fauna from the Upper Cretaceous of the Tesla quadrangle, middle California *1835*
CAMPBELL, GUY: Middle Devonian stratigraphy of Indiana 1055
Cape Cod, Massachusetts, Glacial moraines of western. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
— —, Late Glacial ventifacts of. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer 1127
— —, Mashpee pitted plain. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer 1127
— —, Pleistocene geology of western. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
Casper Mountain fault, Wyoming. By C. J. Hares *1802*
CATHCART, J. B., *et al.*: Status of the Oligocene *1836*
Cave of San Josecito, Nuevo León, Mexico. By Chester Stock *1822*
CHADWICK, G. H.: Laccolith of Frenchman's Bay, Maine *1797*
—: Metasomatic "granite" in Maine..... *1797*
—: Revision of rock series of Mount Desert Island *1796*
CHANEY, R. W.: Topographic significance of facies differences in the Miocene floras of Oregon *1798*
CHAPMAN, R. W.: "Pseudomigmatite" in Piedmont of Maryland 1299
—: Ring structures of Pliny region, New Hampshire 1533

* Full titles of papers are in boldface type; page numbers of abstracts are in italics.

Page

Citellus parryi from the Pleistocene of Alaska. By J. E. Hill..... *1842*
CLARK, B. L., AND CAMPBELL, A. S.: Eocene radiolarians from the Kreyenhagen shales of the Charleston quadrangle, west side of San Joaquin Valley, California..... *1798*
— — —: Radiolarian fauna from the Upper Cretaceous of the Tesla quadrangle, middle California *1835*
CLOUD, P. E., JR., AND WAAGE, K. M.: Early Paleozoic stratigraphy of southern Cherokee County, Alabama *1827*
Coal measures and red-bed section of northern Szechuan, China. By G. D. Louderback *1819*
COLLINS, R. F., AND STOBBE, HELEN: Extrusive and related rocks of northeastern New Mexico *1846*
Colorado-Wyoming, Structure of upper Laramie River Valley. By R. H. Beckwith 1491
CONDRA, G. E., AND ELIAS, M. K.: Ctenostomatous Bryozoa: Carboniferous and Permian forms *1799*
Consolidation history of Idaho batholith. By A. L. Anderson 1099
Continental Slope, Foraminifera of submarine cores from. By F. B Phleger, Jr. 1073
COOPER, B. N.: Moccasin formation in southwestern Virginia *1799*
COOPER, C. L.: North American Chitinozoa.. *1828*
—: Ostracodes from the Cerro Gordo formation (Upper Devonian) of Iowa..... *1828*
COOPER, G. A. (*Chairman*): Correlation of the Devonian sedimentary formations of North America. (Chart 4 of correlation charts prepared by Committee on Stratigraphy of National Research Council) 1729
Corals from Chouteau limestone (Kinderhook) of the Mississippi Valley. By Wm. H. Easton *1829*
— — Redwall limestone (Mississippian) of Arizona. By R. C. Gutschick and Wm. H. Easton *1830*
— — Upper Mississippian of Alabama and Tennessee. By Wm. H. Easton..... *1829*
Correlation and metamorphism of Thomson formation, Minnesota. By G. M. Schwartz 1001
— of Devonian sedimentary formations of North America. By G. A. Cooper (*Chairman*) 1729
— — granites. By M. F. Boos..... *1795*
Cretaceous (Lower) rocks of West Indies. By R. W. Imlay 1417
Critical velocity as a controlling factor in sedimentation. By P. D. Krynine..... *1805*
CRONEIS, CAREY: Ordovician microcrinoid.... *1828*
Ctenostomatous Bryozoa: Carboniferous and Permian forms. By G. E. Condra and M. K. Elias..... *1799*
Cuba, Late Jurassic fossils from. By R. W. Imlay 1417

DAVID, L. R.: Use of fossil fish scales in micropaleontology *1816*
DECKER, C. E.: Some dendroid and hydrozoanlike forms from the Lower Ordovician of Oklahoma *1829*
Deep-sea core faunas (Foraminifera). By F. B Phleger, Jr..... 1073
Delta, Mississippi—a study in isostasy. By A. C. Lawson..... 1231
DEMOREST, MAX, WASHBURN, A. L., AND FLINT, R. F.: Glaciation of Shickshock Mountains, Gaspe Peninsula..... 1211
Deposition by flood in Arroyo Seco, California. By W. C. Krumbein..... 1355
— of ocean sediments, Rate of. By C. S. Piggot and W. D. Urry..... 1187

Page

Deposits associated with wasting glacial ice in the Vermont Valley, from Shaftsbury to Rutland. By C. E. Gordon..... *1847*
Deputy formation of Indiana. By Guy Campbell 1055
Deuteric alteration in Idaho batholith. By A. L. Anderson..... 1099
DEUTSCHMAN, ZYGMUNT: Yellow fever and the development of transportation in the humid tropics *1848*
Development of Northern Allegheny synclinorium and adjoining regions. By G. M. Kay..... 1601
Devonian fishes from Missouri. By E. B. Branson and M. G. Mehl..... *1841*
— sedimentary formations of North America, Correlation of. By G. A. Cooper (*Chairman*) 1729
— stratigraphy of Indiana, Middle. By Guy Campbell 1055
Dinosaur from the Cretaceous of Missouri. By E. B. Branson..... *1841*
DONNELLY, MAURICE: Geomorphic unconformity *1817*
Drift boundary in Missouri, Nebraskan-Kansan. By C. D. Holmes..... 1479
Dry periods of postglacial of Trans-Pecos region, Texas and New Mexico. By K. Bryan and C. C. Albritton, Jr..... 1403
DURHAM, J. W.: Recent Pacific coast coral faunas *1835*
—, *et al.*: Lower Miocene in the Willamette Valley, Oregon *1817*
— — —: Status of the Oligocene..... *1836*
DURRELL, CORDELL: Andesite breccia dikes near Blairsden, Plumas County, California.. *1818*

EARDLEY, A. J.: Tertiary trough near Camp Davis, Wyoming *1809*
Early Paleozoic stratigraphy of southern Cherokee County, Alabama. By P. E. Cloud, Jr., and K. M. Waage..... *1827*
Earthquakes and structure in southern California. By Beno Gutenberg..... *1818*
EASTON, WM. H.: Corals from Chouteau limestone (Kinderhook) of the Mississippi Valley *1829*
—: — — Upper Mississippian of Alabama and Tennessee *1829*
—, AND GUTSCHICK, R. C.: Corals from the Redwall limestone (Mississippian) of Arizona *1830*
EATON, T. H., JR., AND NICOSIA, C. J.: Elasmobranch pectoral fin muscles and nerves *1841*
Ecology of Foraminifera. By F. B Phleger, Jr. 1073
Elasmobranch pectoral fin muscles and nerves. By T. H. Eaton, Jr., and C. J. Nicosia *1841*
ELIAS, M. K.: *Walchia* associated with diagnostic early Pennsylvanian forms in central Colorado *1800*
—, AND CONDRA, G. E.: Ctenostomatous Bryozoa: Carboniferous and Permian forms *1799*
Endocranial anatomy of some Oligocene Artiodactyla. By F. C. Whitmore, Jr. *1842*
Endomorphism of Idaho batholith. By A. L. Anderson 1099
End-stage reactions in Idaho batholith. By A. L. Anderson..... 1099
Eocene larger Foraminifera from Barbados, British West Indies, and a catalogue of the American species of the Discocyclinidae. By T. W. Vaughan.....*1811*
— radiolarians from the Kreyenhagen shales of the Charleston quadrangle west side of San Joaquin Valley, California. By B. L. Clark and A. S. Campbell..... *1798*
Erosion by flood in Arroyo Seco, California. By W. C. Krumbein..... 1355

Page

Extrusive and related rocks of northeastern New Mexico. By R. F. Collins and Helen Stobbe *1846*
Facies of Idaho batholith. By A. L. Anderson 1099
— relation and origin of some Niagaran cherts. By H. A. Lowenstam..... *1805*
FAIRBAIRN, H. W.: X-ray petrology of some fine-grained foliated rocks *1800*
Faunal zones in West Texas barred basin. By R. I. Roth 1659
Faunas of Upper Cambrian of New Jersey. By B. F. Howell *1830*
Feldspar phenocrysts of the Cottonwood granodiorite, Utah. By B. F. Stringham *1823*
FLINT, R. F.: Growth of the North American ice sheet during the Wisconsin age.. *1801*
—, DEMOREST, MAX, AND WASHBURN, A. L.: Glaciation of Shickshock Mountains, Gaspe Peninsula 1211
Flood deposits of Arroyo Seco, Los Angeles County, California. By W. C. Krumbein 1355
FOERSTE, AUG. F., *et al.*: Ozarkian and Canadian cephalopods—Part III: Longicones. *1811*
Foliated dikes and pseudo dikes. By W. J. Miller *1820*
Foraminifera from the Duck Creek formation of Oklahoma and Texas. By Helen Tappan *1833*
— **of submarine cores from Continental Slope: Part 2.** By F. B Phleger, Jr... 1073
Fossils from Cuba and their economic significance, Late Jurassic. By R. W. Imlay 1417
FRASER, H. J.: Metal-producing areas in the western states *1818*
FRITZ, M. A.: Upper Devonian Bryozoa from New Mexico *1829*
FRYXELL, F. M., AND HORBERG, LELAND: Structural surfaces on the west slope of the Teton Range, Wyoming..... *1801*
Function of economic geologists during and after the war. By C. H. Behre, Jr... *1845*
FURLONG, E. L., AND STOCK, CHESTER: Restorations of extinct antelopes from western North America..... *1836*

Gaspe Peninsula, Glaciation of Shickshock Mountains. By R. F. Flint, Max Demorest, and A. L. Washburn..... 1211
Geologic features as bases of major concepts in public education. By J. C. Merriam.. *1820*
Geological research, National Research Council and co-operation in. By W. H. Bucher 1331
Geology of Horse Heaven mine. By L. W. Staples *1822*
— — region of Glacial Lake Missoula, Montana. By J. T. Pardee..... 1569
— — Sierra Cuchillo, New Mexico. By R. H. Jahns *1804*
— — western Cape Cod, Massachusetts, Pleistocene. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
Geomorphic unconformity. By Maurice Donnelly *1817*
Geosynclines, Appalachian. By G. M. Kay.. 1601
Glacial anticyclones and Pleistocene glaciations. By W. H. Hobbs..... *1848*
— deposits of western Cape Cod, Massachusetts. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
— Lake Missoula, Montana, Unusual currents in. By J. T. Pardee..... 1569
Glaciation of Shickshock Mountains, Gaspe Peninsula. By R. F. Flint, Max Demorest, and A. L. Washburn..... 1211
Globotruncana in the Franciscan limestone, Santa Clara County, California. By H. E. Thalmann *1838*
GOLDTHWAIT, R. P., THIESMEYER, L. R., AND MATHER, K. F.: Pleistocene geology of western Cape Cod, Massachusetts..... 1127

Page

GORDON, C. E.: Deposits associated with wasting glacial ice in the Vermont Valley, from Shaftsbury to Rutland..... *1847*
GOTTMANN, JEAN: Soils and men in western Africa and Madagascar *1847*
Gouge is not positive fault evidence. By J. P. Buwalda *1816*
GRAHAM, J. J., *et al.*: Status of the Oligocene *1836*
GRIGGS, A. B., AND WELLS, F. G.: Origin of some chromiferous sands along the southwestern Oregon coast..... *1802*
Growth of the North American ice sheet during the Wisconsin age. By R. F. Flint *1801*
Gulf Coast of Texas, Source of beach and river sands on. By F. M. Bullard..... *1021*
GUTENBERG, BENO: Earthquakes and structure in southern California..... *1818*
GUTSCHICK, R. C., AND EASTON, WM. H.: Corals from the Redwall limestone (Mississippian) of Arizona..... *1830*

HALL, E. R.: New genus of American Pliocene badger, with remarks on the relationships of badgers of the Northern Hemisphere.. *1841*
—, AND STOCK, CHESTER: Skull of a Pliocene badger from Oregon *1837*
Halysites gracilis, (Hall) from the Ordovician of Manitoba. By E. Leith..... *1831*
HANSON, E. P.: Psychological factors in tropical adaptation *1848*
HARES, C. J.: Casper Mountain fault, Wyoming *1802*
HARPER, HERBERT, *et al.*: Lower Miocene in the Willamette Valley, Oregon..... *1817*
HILL, J. E.: *Citellus parryi* from the Pleistocene of Alaska *1842*
HOBBS, W. H.: Glacial anticyclones and Pleistocene glaciations *1848*
—: "Iowan till" of Iowa, an outwash from the Des Moines lobe of the late Wisconsin glaciation *1849*
HODGSON, E. A.: Interior of earth viewed in its relation to earthquake causes; Viewpoint of seismology..... 1073
HOLMES, C. D.: Nebraskan-Kansan drift boundary in Missouri..... 1479
HONIG, P.: Land settlement and soil survey *1849*
HORBERG, LELAND, AND FRYXELL, F. M.: Structural surfaces on the west slope of the Teton Range, Wyoming..... *1801*
HOWELL, B. F.: Age of sponge beds at Little Metis, Quebec *1830*
—: Faunas of Upper Cambrian of New Jersey *1830*
HUFFMAN, G. G.: Middle Ordovician correlations from Lee County, Virginia, to central Kentucky *1830*
Hydrothermal alteration of Idaho batholith. By A. L. Anderson 1099

Idaho batholith, Endomorphism of. By A. L. Anderson 1099
Igneous features of Juniper Ridge, Oregon. By J. E. Allen..... *1815*
— rocks of Livingston, Montana, Origin and structure. By W. H. Parsons..... 1175
— — — Melchior Islands, Antarctica. By Duncan Stewart, Jr. *1802*
— — — Roberts Mountains, Nevada. By C. W. Merriam and C. A. Anderson.... 1675
Illinoian and Wisconsin drift of the Grand River lobe in eastern Ohio. By G. W. White *1813*
IMLAY, R. W.: Late Jurassic fossils from Cuba and their economic significance.... 1417
—: Upper Jurassic formations of the southern States *1803*
Indiana, Middle Devonian stratigraphy of. By Guy Campbell 1055

Page

Interior of earth viewed in its relation to earthquake causes; Viewpoint of seismology. By E. A. Hodgson..... 1073
"Iowan till" of Iowa, an outwash from the Des Moines lobe of the late Wisconsin glaciation. By W. H. Hobbs..... *1849*
Isostasy, Mississippi delta as a study in. By A. C. Lawson..... 1231
JAHNS, R. H.: Geology of Sierra Cuchillo, New Mexico *1804*
Jeffersonville formation of Indiana. By Guy Campbell 1055
Jurassic fossils from Cuba and their economic significance, Late. By R. W. Imlay.... 1417
Kaingining—an important method of crop production in equatorial regions. By R. L. Pendleton *1851*
Kansan drift boundary in Missouri, Nebraskan-. By C. D. Holmes..... 1479
KAY, G. F.: Loveland (Pleistocene) formation of Iowa..... *1804*
KAY, G. M.: Development of Northern Allegheny synclinorium and adjoining regions 1601
—: Middle Ordovician limestones in western anticlines in West Virginia and central Virginia *1831*
KRAUSKOPF, KONRAD: Wallowa batholith.... *1819*
KRUMBEIN, W. C.: Flood deposits of Arroyo Seco, Los Angeles County, California.... 1355
KRYNINE, P. D.: Critical velocity as a controlling factor in sedimentation..... *1805*
—: Provenance versus mineral stability as a controlling factor in the composition of sediments *1850*

Laccolith of Frenchman's Bay, Maine. By G. H. Chadwick *1797*
Lake Calvin and its relation to Illinoian glaciation. By F. Leverett..... 1283
Lake Superior pre-Cambrian, Correlation and metamorphism of Thomson formation of Minnesota. By G. M. Schwartz.... 1001
Land settlement and soil survey. By P. Honig *1849*
Laramie River Valley, Colorado-Wyoming, Structure of upper. By R. H. Beckwith 1491
Late Jurassic fossils from Cuba and their economic significance. By R. W. Imlay 1417
Laurel gneiss. By R. W. Chapman..... 1299
LAWSON, A. C.: Mississippi delta—a study in isostasy 1231
LEITH, E.: *Halysites gracilis*, (Hall) from the Ordovician of Manitoba..... *1831*
Leonard series, West Texas. By R. I. Roth 1659
LEVERETT, FRANK: Shiftings of Mississippi River in relation to glaciation..... 1283
Livingston igneous rocks, Montana, Origin and structure of. By W. H. Parsons.... 1175
Los Angeles County, California, Flood deposits of Arroyo Seco. By W. C. Krumbein 1355
LOUDERBACK, G. D.: Coal measures and red-bed sections of northern Szechuan, China *1819*
Loveland (Pleistocene) formation of Iowa. By G. F. Kay..... *1804*
LOWENSTAM, H. A.: Facies relation and origin of some Niagaran cherts..... *1805*
—: Mid-Triassic crinoid *Dadocrinus*..... *1832*
—: Morphological response of *Ancyrocrinus* to environmental changes..... *1832*
Lower Miocene in the Willamette Valley, Oregon. By J. W. Durham, Herbert Harper, and Beverly Wilder, Jr..... *1817*

Manganese deposits of the Coast Ranges and Sierra Nevada. By N. L. Taliaferro.... *1823*
Marine invertebrate fossils from the Raritan formation of New Jersey. By H. G. Richards *1832*
Maryland, "Pseudomigmatite" in Piedmont of. By R. W. Chapman..... 1299
Mashpee pitted plain, Cape Cod, Massachussetts. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
Massachusetts, Glacial moraines of western Cape God. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer.... 1127
—, Late Glacial ventifacts of Cape Cod. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
—, Mashpee pitted plain, Cape Cod. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
—, Pleistocene geology of western Cape Cod, By K. F. Mather, R. P. Goldthwait, and L. B. Thiesmeyer..... 1127
MATHER, K. F., GOLDTHWAIT, R. P., AND Thiesmeyer, L. R.: Pleistocene geology of western Cape Cod, Massachusetts... 1127
Mazatzal Land, Importance in Paleozoic paleogeography of Arizona. By A. Stoyanow 1255
MCCONNELL, DUNCAN: Phosphatization at Malpelo Island *1806*
MCKEE, E. D.: Cambrian sedimentation in northern Arizona *1820*
MEHL, M. G., AND BRANSON, E. B.: Devonian fishes from Missouri..... *1841*
MERRIAM, C. W., AND ANDERSON, C. A.: Reconnaissance survey of Roberts Mountains, Nevada 1675
MERRIAM, J. C.: Geologic features as bases of major concepts in public education.. *1820*
Metal-producing areas in the western states. By H. J. Fraser *1818*
Metamorphism of Thomson formation, Minnesota, Correlation and. By G. M. Schwartz 1001
— — Wisshickon formation. By R. W. Chapman 1299
Metasomatic "granite" in Maine. By G. H. Chadwick *1797*
Middle Devonian stratigraphy of Indiana. By Guy Campbell 1055
— Miocene vertebrate fauna from Beatty Buttes, Oregon. By R. E. Wallace.... *1839*
— Ordovician correlations from Lee County, Virginia, to central Kentucky. By G. G. Huffman *1830*
— — limestones in western anticlines in West Virginia and central Virginia. By G. M. Kay *1831*
Mid-Triassic crinoid *Dadocrinus*. By H. A. Lowenstam *1832*
MILLER, A. K., *et al.*: Ozarkian and Canadian cephalopods—Part III: Longicones..... *1811*
MILLER, B. L.: Structural sections of Kittatinny (Blue) Mountains in eastern Pennsylvania *1806*
MILLER, W. J.: Foliated dikes and pseudo dikes *1820*
Mineralogy of beach sands on Gulf Coast of Texas. By F. M. Bullard..... 1021
— — facies of Idaho batholith. By A. L. Anderson 1099
Minnesota, Correlation and metamorphism of Thomson formation. By G. M. Schwartz 1001
Mississippi delta—a study in isostasy. By A. C. Lawson 1231
— River in relation to glaciation, Shiftings of. By F. Leverett..... 1283
Missouri, Nebraskan-Kansan drift boundary in. By C. D. Holmes..... 1479
Moccasin formation in southwest Virginia. By B. N. Cooper..... *1799*
Montana, Origin and structure of Livingston igneous rocks. By W. H. Parsons..... 1175
—, Unusual currents in Glacial Lake Missoula. By J. T. Pardee..... 1569
Moraines of western Cape Cod, Massachusetts. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127

Page

Morphological response of *Ancyrocrinus* to environmental changes. By H. A. Lowenstam *1832*
Mount Albert, Gaspe Peninsula. By R. F. Flint, Max Demorest, and A. L. Washburn 1211

National Research Council and co-operation in geological research. By W. H. Bucher 1331
NAUSS, A. W.: Upper Cretaceous ammonites of the genus *Baculites* in California *1836*
Nebraskan-Kansan drift boundary in Missouri. By C. D. Holmes..... 1479
Nevada, Reconnaissance survey of Roberts Mountains. By C. W. Merriam and C. A. Anderson..... 1675
New genus of American Pliocene badger, with remarks on the relationships of badgers of the Northern Hemisphere. By E. R. Hall..... *1841*
New Hampshire, Ring structure of Pliny region. By R. W. Chapman..... 1533
New Mexico, Wind-polished rocks in Trans-Pecos region, Texas and. By K. Bryan and C. C. Albritton, Jr..... 1403
New working hypothesis for the formation, structure, and motions of the earth. By Frederika Blankner..... *1845*
NICOL, A. H.: Recent applications of petrography to the study of concrete disintegration *1821*
NICOSIA, C. J., AND EATON, T. H., JR.: Elasmobranch pectoral fin muscles and nerves *1841*
North America, Correlation of Devonian sedimentary formations of. By G. A. Cooper (*Chairman*) 1729
North American Chitinozoa. By C. L. Cooper *1828*

Occurrence of the genus *Lacazina* Munier-Chalmas in the East Indies. By H. E. Thalmann *1838*
Ocean sediments, Time relations in. By C. S. Piggot and W. D. Urry..... 1187
Ordovician edrioasterids. By G. W. Sinclair *1833*
— microcrinoid. By Carey Croneis..... *1828*
Origin and structure of Livingston igneous rocks, Montana. By W. H. Parsons.... 1175
— of igneous-looking rocks by metamorphism Laurel gneiss. By R. W. Chapman.. 1299
— — some chromiferous sands along the southwestern Oregon coast. By A. B. Griggs and F. G. Wells..... *1802*
Orogeny, middle Upper Jurassic of Cuba. By R. W. Imlay..... 1417
— of northern Allegheny synclinorium. By G. M. Kay..... 1601
Ostracodes from the Cerro Gordo formation (Upper Devonian) of Iowa. By C. L. Cooper *1828*
Ozarkian and Canadian cephalopods—Part III: Longicones. By E. O. Ulrich, Aug. F. Foerste, A. K. Miller, and A. G. Unklesbay *1811*

PABST, A.: Re-examination of hibschite..... *1821*
Paleogeography of Arizona, Paleozoic. By A. Stoyanow 1255
Paleozoic, Correlation of Devonian sedimentary formations of North America. By G. A. Cooper (*Chairman*)..... 1729
— of northern Allegheny synclinorium. By G. M. Kay..... 1601
— **paleogeography of Arizona.** By A. Stoyanow 1255
— stratigraphy of Roberts Mountains, Nevada. By C. W. Merriam and C. A. Anderson 1675

Page

Palisade disturbance, Age of. By R. W. Imlay 1417
Paragenesis of pegmatites within and fringing the Whiteside granite. By L. K. Sharpe *1808*
PARDEE, J. T.: Unusual currents in Glacial Lake Missoula, Montana..... 1569
PARSONS, W. H.: Origin and structure of Livingston igneous rocks, Montana..... 1175
Pebble analyses, Flood deposits of Arroyo Seco, California. By W. C. Krumbein.. 1355
PENDLETON, R. L.: Kaingining—an important method of crop production in equatorial regions *1851*
Permian Basin of West Texas. By R. I. Roth 1659
— province. By R. I. Roth..... 1659
Perrinites zone of West Texas. By R. I. Roth 1659
Petrography of facies of Idaho batholith. By A. L. Anderson..... 1099
— — igneous rocks of Roberts Mountains, Nevada. By C. W. Merriam and C. A. Anderson 1675
— — Laurel gneiss. By R. W. Chapman.... 1299
— — White Mountain magma series of Pliny region, New Hampshire. By R. W. Chapman 1533
Petrology of facies of Idaho batholith. By A. L. Anderson 1099
— — Laurel gneiss. By R. W. Chapman.... 1299
PETTIJOHN, F. J.: Basal Huronian conglomerates of Menominee and Calumet districts, Michigan *1806*
PHLEGER, F. B, JR.: Foraminifera of submarine cores from Continental Slope: Part 2 1073
Phosphatization at Malpelo Island. By Duncan McConnell *1806*
Piedmont of Maryland, "Pseudomigmatite" in. By R. W. Chapman..... 1299
PIGGOT, C. S., AND URRY, W. D.: Time relations in ocean sediments..... 1187
Pitted plain, Cape Cod, Massachusetts, Mashpee. By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
Pleistocene, Estimating time intervals in. By C. S. Piggot and W. D. Urry..... 1187
— **geology of western Cape Cod, Massachusetts.** By K. F. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
Pliny region, New Hampshire, Ring structures of. By R. W. Chapman..... 1533
Post-consolidation changes in Idaho batholith. By A. L. Anderson..... 1099
Postglacial of Trans-Pecos region, Texas and New Mexico. By K. Bryan and C. C. Albritton, Jr. 1403
Pre-Cambrian of Minnesota, Correlation and metamorphism of Thomson formation. By G. M. Schwartz..... 1001
Properrinites zone, West Texas. By R. I. Roth 1659
Provenance versus mineral stability as a controlling factor in the composition of sediments. By P. D. Krynine..... *1850*
"Pseudomigmatite" in Piedmont of Maryland. By R. W. Chapman..... 1299
Psychological factors in tropical adaptation. By E. P. Hanson..... *1848*

Radio elements for estimating geologic time, Disintegration of. By C. S. Piggot and W. D. Urry 1187
Radiolarian fauna from the Upper Cretaceous of the Tesla quadrangle, middle California. By A. S. Campbell and B. L. Clark *1835*
Radium concentrations in ocean-bottom sediments. C. S. Piggot and W. D. Urry... 1187

Page

Rainy season as adverse factor to development of South American tropics. By W. E. Rudolph *1851*
Recent applications of petrography to the study of concrete disintegration. By A. H. Nicol *1821*
— drainage changes in Toowa Valley, southern Sierra Nevada. By R. W. Webb.... *1824*
— Pacific coast coral faunas. By J. W. Durham *1835*
Reconnaissance survey of Roberts Mountains, Nevada. By C. W. Merriam and C. A. Anderson..... 1675
Record of the term "Chico Group" in geologic literature. By F. M. Anderson.. *1815*
Red Mountain area, upper Laramie River Valley, Colorado-Wyoming. By R. H. Beckwith 1491
— — Pass and Ring Mountain area, upper Laramie River Valley, Colorado-Wyoming. By R. H. Beckwith..... 1491
Re-examination of hibschite. By A. Pabst *1821*
Replacement in Idaho batholith. By A. L. Anderson 1099
Restorations of extinct antelopes from western North America. By E. L. Furlong and Chester Stock..... *1836*
Revision of Permo-Triassic sequence at Djulfa, Armenia. By Alexander Stoyanow *1823*
— — rock series of Mount Desert Island. By G. H. Chadwick..... *1796*
RICHARDS, H. G.: Marine invertebrate fossils from the Raritan formation of New Jersey *1832*
Ring Mountain and Red Mountain Pass area, upper Laramie River Valley, Colorado-Wyoming. By R. H. Beckwith.... 1491
— structures of Pliny region, New Hampshire. By R. W. Chapman..... 1533
RITTENHOUSE, GORDON: Transportation and deposition of heavy minerals..... *1807*
River sands on Gulf Coast of Texas, Source of beach and. By F. M. Bullard..... 1021
Rivers of central New Brunswick. By B. Rose *1807*
Roberts Mountains, Nevada, Reconnaissance survey of. By C. W. Merriam and C. A. Anderson 1675
ROSE, B.: Rivers of central New Brunswick *1807*
ROTH, R. I.: West Texas barred basin..... 1659
ROTHWELL, W. T., JR.: Variations of some Foraminifera from the Lower Tertiary Zemorrian stage in southern California.. *1837*
RUDOLPH, W. E.: Rainy season as adverse factor to development of South American tropics *1851*

Salt in West Texas Permian. By R. I. Roth 1659
San Cayetano formation of Cuba. By R. W. Imlay 1417
Sand-dune stratification. By H. T. U. Smith *1852*
Schwagerina crassitectoria zone, West Texas. By R. I. Roth..... 1659
SCHWARTZ, G. M.: Correlation and metamorphism of Thomson formation, Minnesota 1001
Scleractinian corals from the Eocene upper Scotland formation of Barbados and the Miocene of Martinique. By J. W. Wells *1812*
Sediments, Time relations in ocean. By C. S. Piggot and W. D. Urry..... 1187
— of small, soft-water, woodland lakes of northern Wisconsin. By W. H. Twenhofel *1811*
Sequence of Ordovician conodont faunas in Kentucky and adjacent States. By E. B. Branson and C. C. Branson..... *1796*
— — vertebrate faunas in the pre-Tertiary of the Southwest. By C. L. Camp.... *1827*

Page

SHARPE, C. F. S.: Structural relations of the vicinity of Schunemunk Mountain, Orange County, New York..... *1808*
SHARPE, L. K.: Paragenesis of pegmatites within and fringing the Whiteside granite *1808*
SHEPARD, F. P.: Structures in prolongation of the San Andreas fault zone..... *1821*
Shickshock Mountains, Gaspe Peninsula, Glaciation of. By R. F. Flint, Max Demorest, and A. L. Washburn..... 1211
Shiftings of Mississippi River in relation to glaciation. By F. Leverett..... 1283
Shore features, Origin of. By F. M. Bullard 1021
Silver Creek formation of Indiana. By Guy Campbell 1055
SINCLAIR, G. W.: Age of Trenton crinoid beds at Kirkfield, Ontario..... *1833*
—: Ordovician edrioasterids..... *1833*
Skull of a Pliocene badger from Oregon. By Chester Stock and E. R. Hall..... *1837*
SMITH, H. T. U.: Aerial photos in the geological curriculum *1852*
—: Sand-dune stratification..... *1852*
SOHN, I. G.: Upper Jurassic deposits in Brazil *1809*
Soils and men in western Africa and Madagascar. By Jean Gottmann..... *1847*
Some dendroid and hydrozoanlike forms from the Lower Ordovician of Oklahoma. By C. E. Decker..... *1829*
Source of beach and river sands on Gulf Coast of Texas. By F. M. Bullard.... 1021
Southwest, Paleozoic paleography of Arizona. By A. Stoyanow..... 1255
Speeds formation of Indiana. By Guy Campbell 1055
STAPLES, L. W.: Geology of Horse Heaven mine *1822*
Status of the Oligocene. By J. W. Durham, J. B. Cathcart, and J. J. Graham..... *1836*
STEWART, DUNCAN, JR.: Igneous rocks of the Melchoir Islands, Antarctica..... *1809*
STOBBE, HELEN, AND COLLINS, R. F.: Extrusive and related rocks of northeastern New Mexico *1846*
STOCK, CHESTER: Cave of San Josecito, Nuevo León, Mexico *1822*
—, AND FURLONG, E. L.: Restorations of extinct antelopes from western North America *1836*
— — HALL, E. R.: Skull of a Pliocene badger from Oregon..... *1837*
STOYANOW, ALEXANDER: Paleozoic paleogeography of Arizona..... 1255
—: Revision of the Permo-Triassic sequence at Djulfa, Armenia..... *1823*
Stratigraphic importance of the Tintinnidae (Ciliata Heterotrichida). By H. E. Thalmann *1837*
Stratigraphy, Correlation of Devonian sedimentary formations of North America. By G. A. Cooper (*Chairman*)..... 1729
— of Indiana, Middle Devonian. By Guy Campbell 1055
— — northern Allegheny synclinorium. By G. M. Kay..... 1601
— — upper Laramie River Valley, Colorado-Wyoming. By R. H. Beckwith..... 1491
STRINGHAM, B. F.: Feldspar phenocrysts of the Cottonwood granodiorite, Utah..... *1823*
Structural relations of the vicinity of Schunemunk Mountains, Orange County, New York. By C. F. S. Sharpe..... *1808*
— sections of Kittatinny (Blue) Mountains in eastern Pennsylvania. By B. L. Miller *1806*
— surfaces on the west slope of the Teton Range, Wyoming. By F. M. Fryxell and Leland Horberg *1801*
Structure in northern Allegheny synclinorium, Paleozoic. By G. M. Kay..... 1601

Page

Structure of Livingston igneous rocks, Montana, Origin and. By W. H. Parsons.... 1175
— — ring dike complex, Pliny region, New Hampshire. By R. W. Chapman..... 1533
— — **upper Laramie River Valley, Colorado-Wyoming.** By R. H. Beckwith..... 1491
Structures in prolongation of the San Andreas fault zone. By F. P. Shepard.... *1821*
— of Pliny region, New Hampshire, Ring. By R. W. Chapman..... 1533
Subdivisions of Idaho batholith. By A. L. Anderson 1099
Submarine cores from Continental Slope, Foraminifera of. By F. B Phleger, Jr. 1073
Swanville formation of Indiana. By Guy Campbell 1055
Synclinorium, Development of northern Allegheny. By G. M. Kay..... 1601

Tabletop Mountain, Gaspe Peninsula. By R. F. Flint, Max Demorest, and A. L. Washburn 1211
TALIAFERRO, N. L.: Manganese deposits of the Coast Ranges and Sierra Nevada..... *1823*
TAPPAN, HELEN: Foraminifera from the Duck Creek formation of Oklahoma and Texas *1833*
"Temporary Mississippi," relation to Illinoian glaciation. By F. Leverett..... 1283
Ten years of research work in Foraminifera (1931-1940). By H. E. Thalmann..... *1810*
Tertiary formations at Coos Bay, Oregon. By C. E. Weaver..... *1824*
— trough near Camp Davis, Wyoming. By A. J. Eardley..... *1800*
Texas, Source of beach and river sands on Gulf Coast of. By F. M. Bullard..... 1021
— and New Mexico, Wind-polished rocks in Trans-Pecos region. By K. Bryan and C. C. Albritton, Jr..... 1403
— barred basin, West. By R. I. Roth..... 1659
THALMANN, H. E.: Additional species of the genus *Globotruncana* Cushman..... *1809*
—: *Globotruncana* in the Franciscan limestone, Santa Clara County, California.. *1838*
—: Occurrence of the genus *Lacazina* Munier-Chalmas in the East Indies.... *1838*
—: Stratigraphic importance of the Tintinnidae (Ciliata Heterotrichida)..... *1837*
—: Ten years of research work in Foraminifera (1931-1940) *1810*
THIESMEYER, L. R., MATHER, K. F., and GOLDTHWAIT, R. P.: Pleistocene geology of western Cape Cod, Massachusetts... 1127
Thomson formation, Minnesota, Correlation and metamorphism of. By G. M. Schwartz 1001
Thrusting in Roberts Mountains, Nevada. By C. W. Merriam and C. A. Anderson 1675
Time relations in ocean sediments. By C. S. Piggot and W. D. Urry..... 1187
Topographic significance of facies differences in the Miocene floras of Oregon. By R. W. Chaney..... *1798*
Trans-Pecos region, Texas and New Mexico. Wind-polished rocks in. By K. Bryan and C. C. Albritton, Jr..... 1403
Transportation and deposition of heavy minerals. By Gordon Rittenhouse..... *1807*
TWENHOFEL, W. H.: Sediments of small soft-water, woodland lakes of northern Wisconsin *1811*

ULRICH, E. O., *et al.*: Ozarkian and Canadian cephalopods—Part III: Longicones *1811*
United States, Correlation of Devonian sedimentary formations of. By G. A. Cooper (*Chairman*) 1729
UNKLESBAY, A. G., *et al.*: Ozarkian and Canadian cephalopods—Part III: Longicones *1811*

Page

Unusual currents in Glacial Lake Missoula, Montana. By J. T. Pardee..... 1569
Upper Cretaceous ammonites of the genus *Baculites* in California. By A. W. Nauss *1836*
— Devonian Bryozoa from New Mexico. By M. A. Fritz..... *1829*
— Jimmy Creek area, upper Laramie River Valley, Colorado-Wyoming. By R. H. Beckwith 1491
— Jurassic deposits in Brazil. By I. G. Sohn *1809*
— — formations of the southern States. By R. W. Imlay..... *1803*
— rapids of Mississippi River, Date and method of channeling. By F. Leverett 1283
URRY, W. D., AND PIGGOT, C. S.: Time relations in ocean sediments..... 1187
Use of fossil fish scales in micropaleontology. By L. R. David..... *1816*

Variations of some Foraminifera from the Lower Tertiary Zemorrian stage in southern California. By W. T. Rothwell, Jr. *1837*
VAUGHAN, T. W.: Eocene larger Foraminifera from Barbados, British West Indies, and a catalogue of the American species of the Discocyclinidae..... *1811*
Ventifacts of Cape Cod, Massachusetts, Late Glacial. By K. P. Mather, R. P. Goldthwait, and L. R. Thiesmeyer..... 1127
Volcanoes of the Three Sisters region, Oregon Cascades. By Howel Williams..... *1825*

WAAGE, K. M., AND CLOUD, P. E., JR.: Early Paleozoic stratigraphy of southern Cherokee County, Alabama.. ..... *1827*
Walchia associated with diagnostic early Pennsylvanian forms in central Colorado. By M. K. Elias..... *1800*
WALLACE, R. E.: Middle Miocene vertebrate fauna from Beatty Buttes, Oregon..... *1839*
Wallowa batholith. By Konrad Krauskopf *1819*
WASHBURN, A. L., FLINT, R. F., AND DEMOREST, MAX: Glaciation of Shickshock Mountains, Gaspe Peninsula..... 1211
Water supply in North Carolina Coastal Plain. By Willard Berry..... *1795*
WEAVER, C. E.: Tertiary formations at Coos Bay, Oregon *1824*
WEBB, R. W.: Recent drainage changes in Toowa Valley, southern Sierra Nevada *1824*
WELLS, F. G., AND GRIGGS, A. B.: Origin of some chromiferous sands along the southwestern Oregon coast..... *1802*
WELLS, J. W.: Scleractinian corals from the Eocene upper Scotland formation of Barbados and the Miocene of Martinique.. *1812*
West Texas barred basin. By R. I. Roth.. 1659
WHEELER, H. E.: Age of the Rocky Mountain quartzite in southern Alberta..... *1839*
WHEELER, R. R.: Cambro-Ordovician of the Southwest *1812*
WHITE, G. W.: Illinoian and Wisconsin drift of the Grand River lobe in eastern Ohio *1813*
WHITMORE, F. C., JR.: Endocranial anatomy of some Oligocene Artiodactyla..... *1842*
WILDER, BEVERLY, JR., *et al.*: Lower Miocene in the Willamette Valley, Oregon..... *1817*
WILLIAMS, HOWEL: Volcanoes of the Three Sisters region, Oregon Cascades..... *1825*
Wind-polished rocks in Trans-Pecos region, Texas and New Mexico. By K. Bryan and C. C. Albritton, Jr..... 1403
Wissahickon formation. By R. W. Chapman 1299
Wyoming, Structure of upper Laramie River Valley, Colorado. By R. H. Beckwith 1491

X-ray petrology of some fine-grained foliated rocks. By H. W. Fairbairn..... *1800*

Yellow fever and the development of transportation in the humid tropics. By Zygmunt Deutschman *1846*